For the Advanced Computer User

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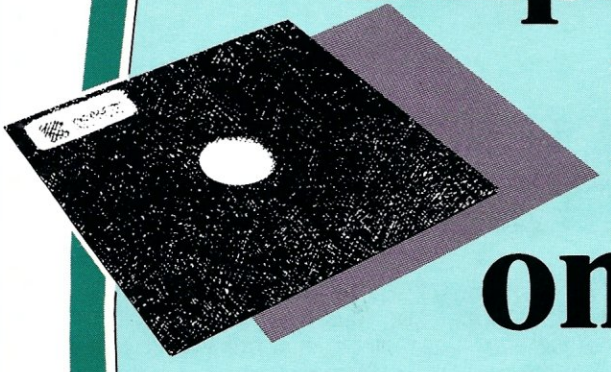

Implementing PC-DOS on Non-IBM Compatible Computers

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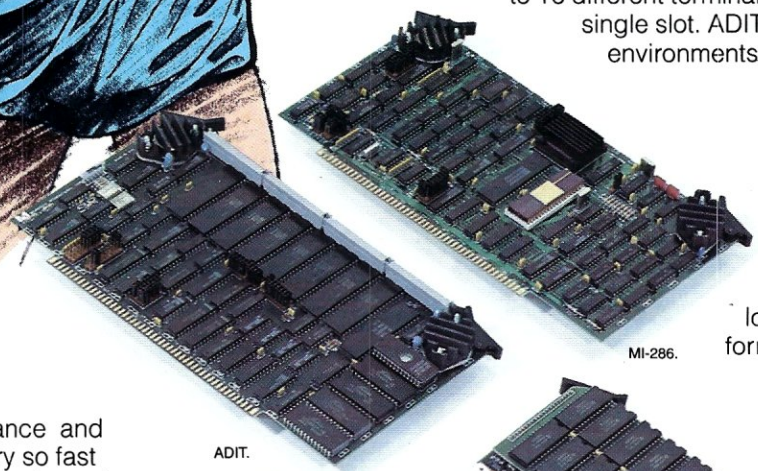

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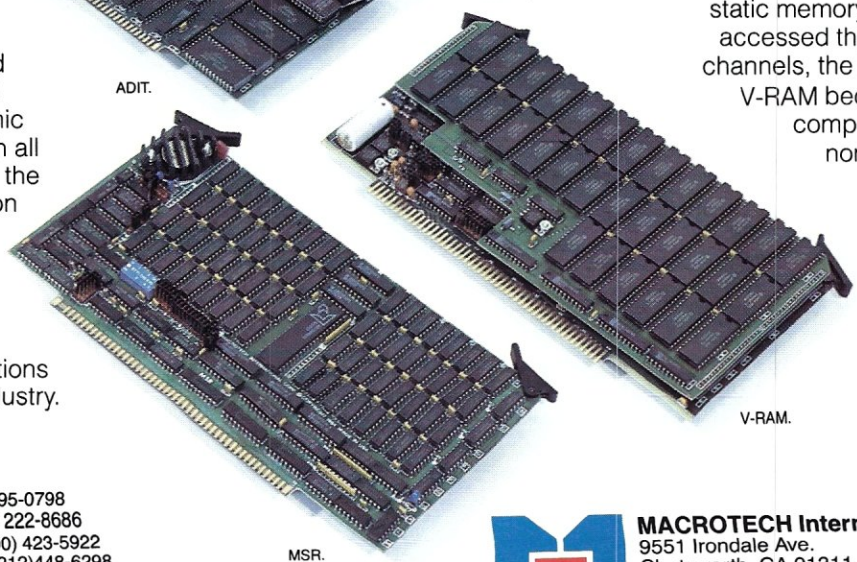

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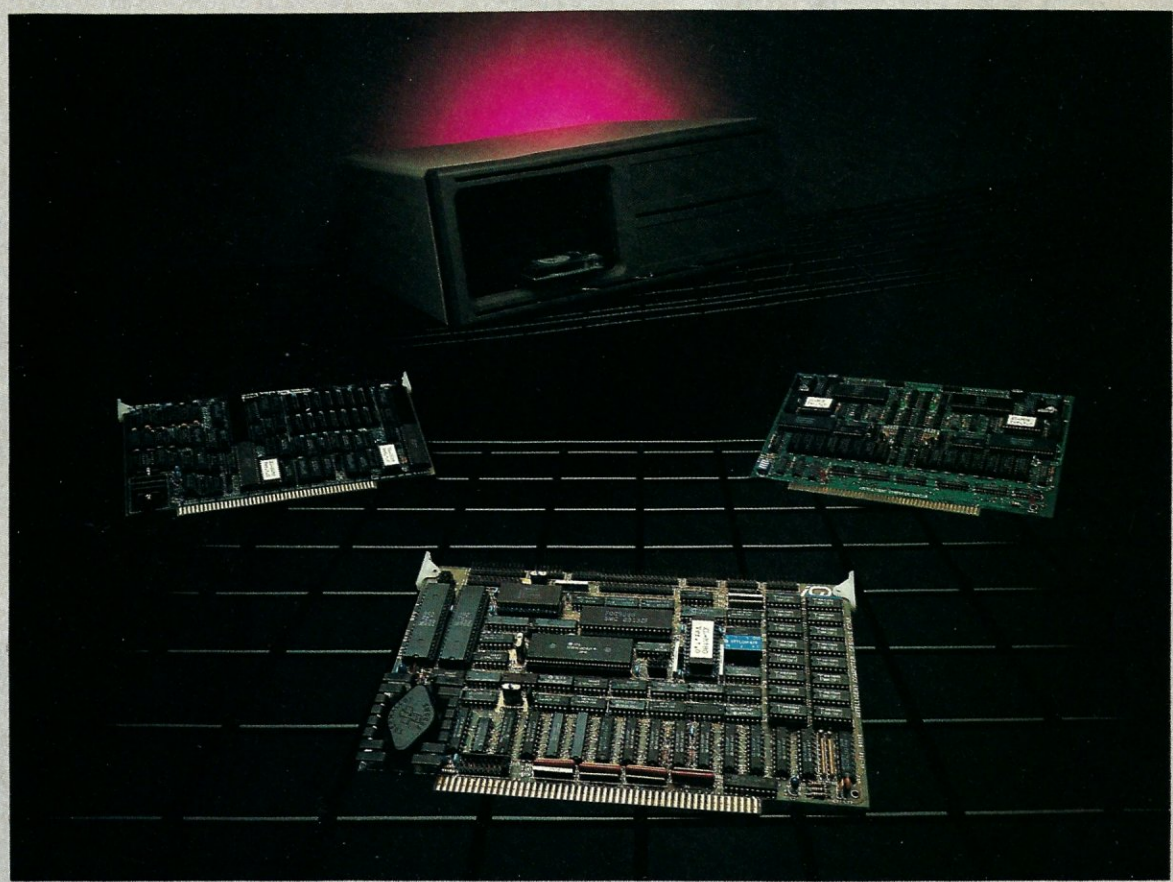

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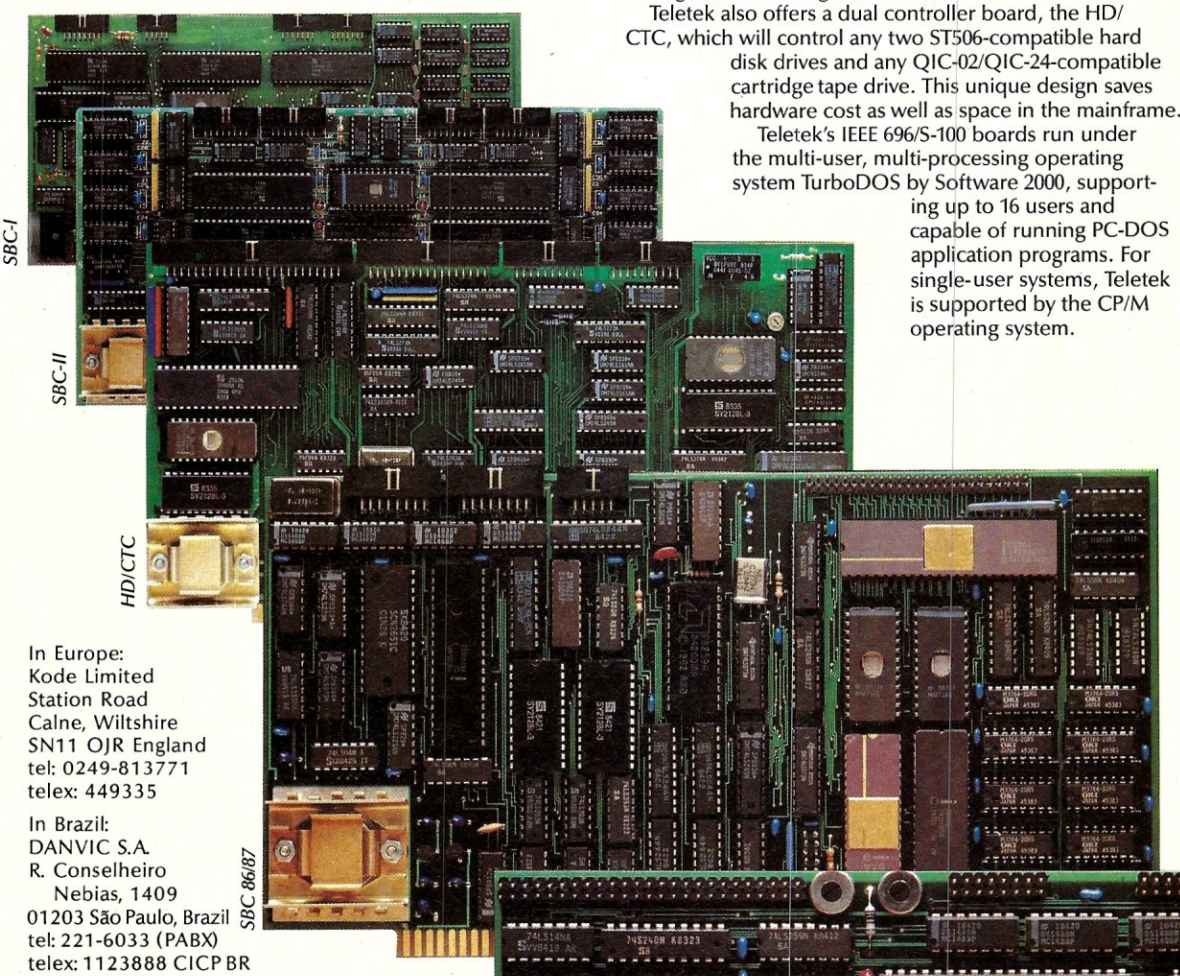

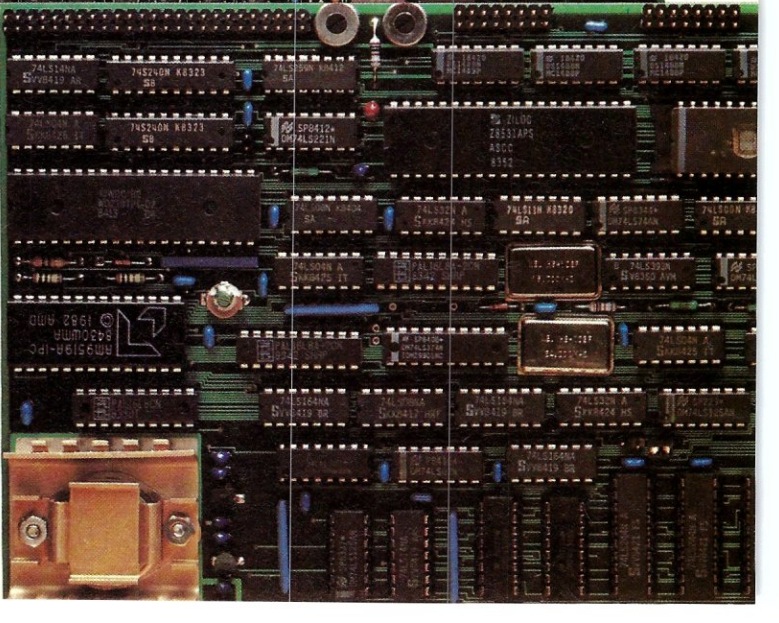

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68000, 68010,68020	Motorola

Editor's Page

by Sol Libes

SETTING THE RECORD STRAIGHT

IBM has long been considered the "Master of Computer Marketing" and the PC just another in a long series of mighty triumphs. There is no doubt that the PC is a huge success. But let it not blind us to IBM's failures and not-so-successful products.

I would therefore like to "set the record" straight by reviewing IBM's track record in the personal-computer field. It is my opinion that another company, without the huge financial resources of IBM, would have long been out of the business had they made the same marketing errors.

A BIT OF PC HISTORY

Virtually everyone I come in contact with seems to think IBM's first entry into the personal-computer field was the PC, introduced in 1981. Nothing could be further from the truth. In fact, it was IBM's third attempt, the first two being colossal failures that would have driven a smaller company quickly into the Chapter-11, bankruptcy court.

IBM's first desktop, personal computer (the 5100) was actually introduced in early 1978 and was called the 5100. It had a 5" CRT display (I bet you thought Osborne was the first), a standard keyboard, and a tape cartridge for storage. Two versions were available, with either Basic or APL in ROM. There was very little program support, and no compatibilty with other systems on the market. In addition the price was over twice that of the Altair and IMSAI (the market leaders, at the time) and the machine was only sold by IBM's internal sales staff. It was apparent that IBM did not think much of the desktop market at the time, since virtually no promotional effort was put into the product.

At the time, Apple was still a garage operation selling a computer on a PC board (the Apple I). And Commodore was still showing prototypes of its PET computer and trying to get it into production. By the fall of the year, Apple was organized into a real company and had introduced the Apple II. Commodore was shipping the PET and Radio Shack introduced their TRS-80 Model I. IMSAI was also selling a desktop unit running Microsoft Basic. The machines were being bought mostly by computer hobbyists.

The 5100 fell flat on its face. In 1979 IBM introduced the 5110. By this time the Radio Shack, Commodore, and Apple computers were being shipped in large numbers to several hundred computer stores around the country. Users were starting to add 5-1/4" floppy disks to their systems. VisiCalc had been introduced for these machines, as well as some decent word-processing and database software. IBM salesmen were shocked to find that personal computers were appearing on the desks of their business customers.

The 5110 was essentially an upgraded version of the 5100. It still used IBM's proprietary 8-bit microprocessor, but now had floppy-disk drives. The unit looked like an oversized calculator with a large floor-standing cabinet, housing dual 8" floppies. The screen was upgraded to display 16, 64-character lines. Applications software, which included the traditional business applications for dentists, travel agents, etc., was rented rather than sold outright. The system cost was still more than twice that of other personal computers on the market and users were completely dependent on IBM for software and support.

By mid-1980, IBM realized that the 5110 was also a failure, as Apples, TRS-80s, PETs multiplied on office desks, invaded classrooms, and seemed to be popping up everywhere. It began to look like a repeat of the same situation that had occurred in the minicomputer field when IBM was only a minor player and the minis were growing in power and taking over applications that once were the exclusive domain of large mainframes.

THE PC TO THE RESCUE

IBM realized that it had to do something quickly. It therefore decided if it could not sell a desktop system in its traditional way, it would try to emulate its competitors in system design and marketing. Thus was created the 5150, better known as the "PC".

IBM looked around for a quick solution. The company decided to bring out a machine using the popular Z80, 8-bit microprocessor running the CP/M operating system and MBasic and sell it via the same outlets that carried the Apple computer. They undertook negotiations with Digital Research Inc. (developers of CP/M) and Microsoft (developers of MBasic). They found DRI to be very independent, while Microsoft was very cooperative. Bill Gates of Microsoft pointed out that 16-bit microprocessors (e.g. the 8088 and 8086) were already available and that a nearby company (Seattle Computer Products) had already migrated MBasic to the 8086/8088 and created a 16-bit version of CP/M. And, that if DRI was being independent, maybe IBM should consider a 16-bit machine instead of an 8-bit one. Microsoft offered to handle both the operating system and Basic language processor. IBM, under time pressure, bought the deal.

The machine was thus essentially a copy of machines like the Apple and TRS-80 with few improvements. Like the Apple, it came with 16K of memory, a cassette interface, some slots for add-on boards, Basic in ROM, color graphics with about the same resolution, and an optional disk drive with only a little more storage than the Apple's. The software IBM introduced was virtually the same that was available for the Apple. The price was essentially the same as the Apple's and IBM offered it through Computerland and Sears, Apple's two biggest retail outlets. One could make a strong argument that IBM created an Apple-like clone. One thing is for sure.....IBM did not create an advance in technology. Rather, it was attacking a marketing problem with a quick and cheap solution.

Where IBM did pioneer was in the marketing of personal computers. They

invested a tremendous amount of money in advertising, promotion, and training of dealers. They insisted on dealers investing money in transforming their dishevele d, little low-overhead computer stores from havens for computer hobbyists to carpeted, fancy-furniture establishments with pin-stripe, high-pressure salespeople.

One other thing happened to help IBM. The govenment decided to drop their antitrust suit against Big Blue. With that problem off its back IBM decided to really show it could compete in the PC marketplace. IBM took advantage of its incredible manufacturing and marketing capability to set new standards for computer pricing that has allowed it to assume the dominant position in the market, forcing many competitors out. It is beginning to look like a repeat of what IBM did in the mainframe business, when IBM forced companies like RCA and GE out of the business. IBM has already forced companies like Osborne, Otrona, Gavilan, Hyperion, Columbia, Actrix, and Victor Technologies out and left several others gasping. IBM's recent aggressiveness in the PC software area has already done-in several software companies and more are on their way out. We may again see the government haul IBM into court on antitrust action.....but by then it may be too late, as it was in the mainframe business.

We should also add to IBM's failure list the PCjr and PC Portable. And there is some question as to the success of the AT as most dealers are heavily discounting the unit in order to move accumulating inventory (see "News" column).

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News, Views & Gossip

by Sol Libes

RUMORS & GOSSIP

The PC Technical Group of the Boston Computer Society has undertaken an ongoing study of Scientific Word Processors. After 10 months of work the group (composed of 12 scientists from MIT, Harvard, Brandeis, and industry) have issued their first report. It is without doubt the most thorough study I have seen so far and I recommend it to anyone considering the purchase of a SWP. For a copy send $8 (U.S., Canada & Mexico), $10 elsewhere, to: Carl A. Hein, Dunster House Apt Z, Swanson Road, Boxborough MA 01719. Make the check payable to Carl.

Jon Shirley, President of Microsoft, recently boasted that Xenix has an installed base of 120,000 systems. This is probably 70% of the Unix systems in operation today. Of course the most popular Xenix-based system is the Tandy Model 16. With Xenix's new System V compatibility and Microsoft's promise of MS-DOS/Xenix software compatibility, Xenix systems will surely continue to far outnumber other Unix implementations. Shirley also recently disclosed that Microsoft is working on programs to do speech-to-text files and video-pictures-to-graphics files.

Atari has signed a Unix System V licensing agreement for use with its 68000-based ST series and its future 32-bit computer lines. Such an agreement typically sells for $50,000. It is rumored that Atari will introduce a new entry in the ST series shortly running System V, with built-in hard disk and 1Mbyte of memory. The 32-bitter is expected later in the year.

Apple is expected, at its upcomming stockholders meeting, to introduce new versions of the IIe and Mac. Look for the Mac to have 1Mbyte of RAM, more ROM, 800K floppy drive and expandability. The IIe will get a new operating system and limited Mac compatibility. In the fall, expect a new version of the Mac based on the 68010, a separate larger monitor, 4Mbyte memory expansion, built-in hard disk options and a bus with slots for expansion.

Early word is that AT&T may finally have a winner in the new 6300+ machine. It has a 286, is AT-compatible, faster, has more expansion slots and runs UNIX with MS/DOS as a task. Both share the same file structure so that files can be easily moved between the two. In fact a user, while in UNIX, can run DOS programs and execute DOS commands. Software developers should love it.

And, look for something new in spelling checker programs. Some newer ones sit in background checking spelling as text is entered.

KayPro continues to lose money. They posted a loss for the fourth quarter ending August 31st due to poor sales. The company had reported losses for the previous five quarters.

CD ROMs may be the hot new item for 1987. Microsoft and IBM are known to be working hard to develop such systems for personal computers. Toward this end, Microsoft will run the "First International Conference On CD ROM" in March.

Racal-Vadic has announced a new modem for personal computer users that can blaze along at 9600 baud. It also supports 300 and 1200 baud transmission. Cost is $1,495.

Digital Research, in an attempt to get Concurrent PC-DOS off dealer shelves has modified it to work with the AST Rampage extended memory spec (a superset of the Lotus/Intel/Microsoft standard to access memory beyond 640K). So far it is estimated that DRI has sold only 15,000 copies of Concurrent plus some OEM deals.

PC-Net WHERE ARE YOU?

Novel, 3Com and AST are beating IBM and Microsoft to the punch. They are expected to momentarily release upgrades of their networking systems to MS-DOS 3.1 compatibility. Are we seeing a situation where IBM is developing standards only to lose out to competition? It is interesting to note that although IBM has 80% of the PC/XT sales in the U.S. they have less than 50% outside the U.S.

IBM has finally released its first PC-Net interface/controller card. It looks like it contains more processing power than a PC. I haven't heard the price yet. But considering the high cost of the card and the interconnecting coaxial cabling system there is some doubt as to whether this is going to make it. In the meantime companies like Novel, etc. are having great success with lower cost twisted-pair networking systems. I have heard of some organizations using some of the unused telephone circuits in their buildings for networking interconnections. There is no doubt there have been significant improvements in digital signal processing circuits that make it possible to ship data at 10Kbits/sec, and higher, over lower quality lines.

TIS THE SEASON

The Christmas season has become the make-or-break time of the year for computer hardware vendors and dealers. And '85 Yuletide sales have become even more important after a very slack first three quarters. If Christmas sales are not good we will see more shakeouts in the first quarter of '86.

The key players are IBM, Apple, Commodore and Atari. Recognizing that the Apple-II and Mac are selling mostly to the home market and Commodore's Amiga and Atari's ST520 are priced lower, Apple cut prices in early October. The IIc was cut 23% to $995 with a color monitor and printer, while the IIe and Mac were cut 17.5% and 10.5% respectively.

IBM is going with dealer rebates which few dealers are expected to past on to customers because of discount and volume pressures from IBM. IBM is offering the system to dealers for $500 (minimum order, 40 systems) with deferred payment until March and full return privileges. The street price is expected to be between $650 and $750 with a color monitor included. However, the general feeling is that this is not enough to move the large number of units still in IBM warehouses and dealer inventory.

Commodore claims to have signed up over 700 dealers for its new Amiga based on a very substantial discount structure and very liberal ordering terms. At $1,295 the system is competing head-on with the two-year old Macintosh. Although by far the most advanced personal computer currently available, it is a very expensive home system and a very limited professional system. I doubt it can succeed where the Mac, with better promotion and distribution, so far, has not been able to.

Atari is betting on the low price ($799) of the ST520 to compete against the Apple II. This is a terrific price for a 68000-based system with 512K RAM, monitor, mouse, disk drive, system software and two languages. Although the basic system has been shipped since early July, peripheral support and application software have been slow to appear. Software developers have found it more difficult to develop software to run under the GEM operating system than under earlier, and simpler, operating system. This same situation slowed Mac sales and will no doubt also affect the Amiga and ST520.

Atari and Commodore have gotten a very cool reception from chain stores, who are still trying to move large inventories of the Coleco Adam, Commodore VIC20 and C64, and Atari 800. Since both companies need to move very large quantities of machines, this is not a good sign for them.

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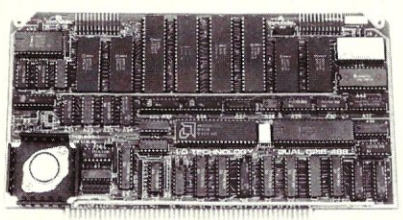

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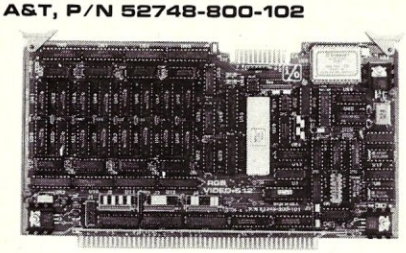

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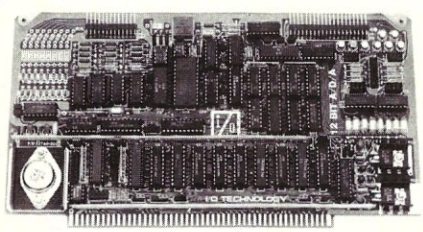

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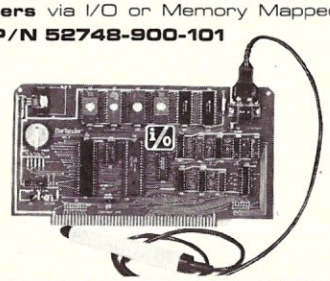

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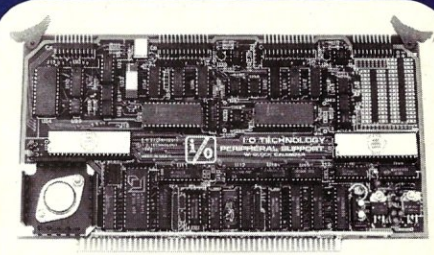

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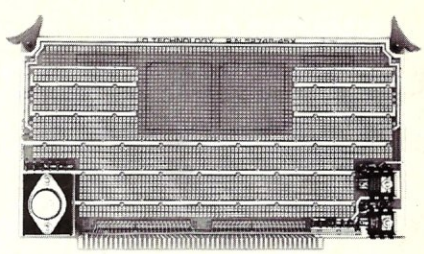

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MAGAZINES COME & GO

There are two new magazines worthy of note. "S-100 Journal" is published quarterly by Octoplus Corp., 2426 Wade Ave, Raleigh NC 27607. Subs are $14 (1 yr.) and $25 (2 yrs.). Add $3/yr outside U.S. Their first issue was 48 pages. "Multi-User" is published monthly by High Tech Publishing Co., Box 901, Centreville VA 22020. Although they charge for subs, 90% of the readers currently get it free of charge. They have already published three 60-page issues.

Several magazines have ceased publication. In fact, most seem to come and go almost as quickly as software companies.

Lifelines, a CP/M oriented magazine published for several years by Lifeboat Associates, ceased publication early last year.

Creative Computing, one of the pioneering personal computer magazines, edited by Dave Ahl and sold to Ziff-Davis in 1982, was shut down by Z-D. If my count is correct, that makes 9 computer publications Z-D has closed up.

Popular Computing, McGraw-Hill's low-brow version of Byte was also shut down.

Compas, published for several years by the International North Star Users Association, ceased publication last fall. And Business Unix died after only three issues.

THE HIGH COST OF LASER PRINTERS?

Not long ago we bought a copier for our flegling publishing operation.....a Cannon PC-25 copier, the top-of-the-line model. It has two reduction and one enlargement modes, handles legal as well as letter size, plus some other features. The cost was $835 while the list was close to $1,400.

What intrigues me is that I have been given to understand that the basic guts of the machine are the same as that used on the HP and Apple laser printers. This set me to thinking. How much could the extra electronics and laser circuitry cost? Surely not the extra $2,000 (HP) or $4,000 (Apple) charges, at discount prices!

It appears to me that HP and Apple must be making a killing on their laser printers. I will have to wait for the competition to develop. I sure would like to get a laser printer with downloadable font and graphics capability!

It appears that I may not have to wait much longer as several printer vendors are preparing products to sell at significantly lower prices. NEC, Epson, Ricoh, and others are expected to shortly introduce systems for shipment starting early this year. It therefore appears possible that we may see laser printers and printers using competing LCD and LED technology selling for well under $2,000 and possibly even as low as $1,000 by year end.

PC & AT CLONE PRICES DROPPING

Over two dozen AT compatibles are already on the market. The result is that AT prices are dropping fast. More than one outfit is already selling a basic AT clone for under $2,000 (see article in this issue) .... less than half the cost of a comparably equipped IBM-AT.

The IBM-AT, which is overflowing dealer inventories, got a $350 rebate. However, IBM introduced a new AT model with a 30Mbyte drive for only $200 more than the 20Mbyte unit. This is expected to put pressure on dealers to clear out their 20M ATs.....look for the units on the grey market at substantial discounts.

In the meantime PC/XT clone prices are dropping fast. At a recent flea market XT-clone motherboards, fully loaded with 256K of RAM and BIOS ROM were being offered for $135. And a system, with display, 2 drives, 256K RAM and graphics controller and 90 day warranty could be had for $695. And mail order prices are dropping too....just check out the Atlaz ad in this issue. We will attempt to review some of the low-cost AT clones as soon as we can get our hands on them.

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LANPC	$371	ARCNET Controller IBM-PC BUS
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HUB-4P-ENC	$41	Passive Hub-4 Port
HUB-8A	$319	Active Hub-8 Port
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MD-1013	$521	Monitor Dynamics HD Controller
MD-1016	$521	Monitor Dynamics HD Controller
OMTI-5100	$521	HD Controller-SASI Interface
OMTI-5300	$596	HD & TAPE Cartridge Controller-SASI Interface

CARTRIDGE TAPE DRIVES

T-540	$975	Cipher, 90 IPS, 45/60 MB
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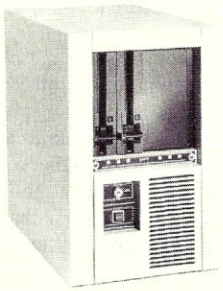

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CPZ-186-512	$1271	80186 8MZ 512K Master Processor
CPZ-186-1MB	$1496	80186 8MZ 1MB Master Processor

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CPS-16-512	$971	8086 8MZ 512K Slave-Memory Mapped
CPS-16-1MB	$1196	8086 8MZ 1MB Slave-Memory Mapped
CPS-186	$971	80186 10MZ 256K Slave-Memory Mapped
CPS-16-512	$1121	80186 10MZ 512K Slave-Memory Mapped
CPS-186-1MB	$1346	80186 10MZ 1MB Slave-Memory Mapped
CPS-286	AVAILABLE-3rd Quarter, 1985	

ARCNET WORKSTATIONS

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WS80-6A-ENC	$896	WS80-6A with Enclosure & Power Supply

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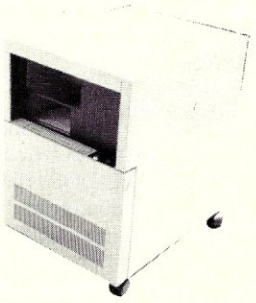

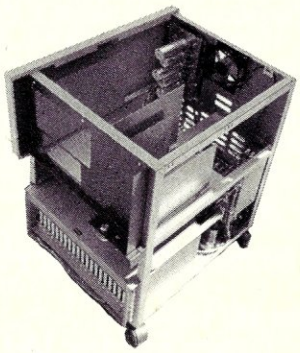

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The Language	$995	O'Hanlon Systems

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Word Processor	$250	Palantir, 16 bit, **AVAILABLE IN SEPTEMBER, 1985**
The Filer	$145	Palantir, 8 bit
The Speller	$145	Palantir, 8 bit

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Letters to M/SJ

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Please send your letters to: Micro/Systems Journal, Box 1192, Mountainside NJ 07092.

Dear Sol,

In response to Robert Savage's letter published in the Sept/October issue, I suggest that he look closer at the "Z-100 Main Board schematics". Although I built my H-100 over a year ago, I believe they are the same.

Sheet 4 of my schematics shows that the 2661's have their own crystal of 4.9152 Mhz for baud rate generation on the serial ports. The 8085-2 on sheet 1 has a 10 Mhz crystal which gives a system clock of 5 Mhz, not 4.9 Mhz that Mr, Savage claims. The only apparent side effect is that the 8085's instruction execution will be slower if he reduced the crystal to 8 Mhz.

I have been planning to increase the 8-bit system clock to 6 Mhz (12 Mhz crystal) to get a 20 percent increase in speed. My 8088 has been upgraded to an 8088-2 that runs at 8 Mhz and haven't had any communication problems.

David S. Podejko
Norwalk, CT

P.S. Continue the excellent publication.

Dear Mr. Libes:

Strongly discourage IBM specific stuff. The world is flooded with IBM-PC only magazines. Favor generic MS-DOS, CP/M-80 and CCP/M-86 and hardware that is a little more exploratory. Compatibility will surely destroy you, so encourage diversity as editorial policy.

Do not hitch your magazine to a dying horse (UNIX). The great majority of micro-computer users (including advanced users) just skip any article that features UNIX. Your readers ARE NOT USING MINICOMPUTERS! Why pretend that UNIX is for micros?

For general programming illustrations I find C less than ideal. It is often crptic and not nearly as portable as Turbo Pascal. Turbo code will run under CP/M-80, CP/M-86, MS-DOS and PC-DOS (and everyone can afford it).

Andrew Grygus
La Crescenta CA

Editors,

I bought an IBM PC-compatible computer recently, because it seems to me that IBM-like computers are becoming quite common. I am an advanced computer user interested in all aspects of micro-computers: hardware, software, marketing strategy, public domain, etc. I would hate to see you exclude IBM-like discussions just to satisfy John T. Linnell and Bernard S. Gorman (letters in vol. 1 and 3). Please continue your excellent articles such as S-100 to PC-bus conversion board.

Graeme McRae
Monmouth Junction, NJ

Dear Lennie and Sol:

Thanks for sending the complimentary July/August issue. It is a prized supplement to BYTE and the C-PRO Newsletter.

As a just-over-a-year owner of a CompuPro 816/C, I was greatly impressed with your "new" publication. To support your effort, I am enclosing a check to cover a one-year subscription and copies of the two previous issues.

The articles/reviews were excellent, especially "Concurrent PC-DOS" by Guttman and Mills. It was a refreshing change from the diatribe usually found in PC-World. (It seems many of these writers are convinced that microcomputers were born late in 1981 with the IBM-PC, rather than in 1975 with the Altair.)

Guttman and Mills identified the IBM-PC hardware as a very severe limitation to C/PC-DOS. Having just looked at an early version of the PC and Multimate, I would suggest another problem: non-partitioned programs.

Multimate requires its entire 136k program to be resident in RAM. Contrast this to partitioned programs where only the command file be need be resident on RAM. The remaining overlays can remain on disk or in an AboveBoard type RAM-disk., A few "vanella" examples follow (CMD/OVL): WordStar-Pro (22k/204k), SuperCalc-2 (34k/36k), DBASE-2 (20k/104k).

Having used MP/M8-16 v2.1F for over a year, I find the above mentioned "vanella" programs are excelent in this environment. Based on experience and from studying multiple CPU theory, I perceive no reason these programs should not work simultaneously on an 85/88 CPU board.

About windows, I find a normal screen difficult enough to read with reducing the displayed information available. Further, I have found little benefit for a single user to operate on more than one program at a time. (The procedure is easy in MP/M, just move the terminal cable to a new console and sign on.)

The single exception is in debugging programs. When an errant programs "hangs" a terminal, just move to a vacant terminal and issue the command: ABORT CMD-PRG #, where # is that of the hung terminal. This saves a reset and preserves the M-Drive configuration exactly as is. (No chance of MFORM crashes.)

I am looking forward, someday, to purchasing the the MI-286/287 board (reviewed in the same issue). Between DR's CB-86 and C compilers, I should have many math-intensive programs to utilize this board.

Adrien J. Dubreuil
Derby, CT

Dear Sirs,

Welcome back! Good to see the return of your magazine - it was sadly missed. I hope you will keep up the level of hardware contributions and stop it from becoming yet another software-oriented periodical.

Regarding 32-bit processors on the S-100 bus: If Peter Thiessen is interested in putting a 68K CPU on it, may I suggest he take a look at Robert Groppo's (of Morrow Designs) article "S100 Bus adapted to 68000-based Unix Computer" in Computer Design, March 1985. Although he doesn't present much meat, Mr. Thiessen may find it a starting point. I have not, unfortunately, found any article for the 32000 series. Anyone know of one? Or could you persuade National Semiconductor to recognize the benefits which accrue to its 32016 processor (trailing badly behind Motorola's 68000 in the 16-bit (bus-width!) stakes) by public-domain involvement and present an article detailing an interface?

I don't know what your feelings are on upgrading this bus to accommodate full 32-bit pathways, but I feel a good case could be made for a change in the mechanical specification. In particular, the designers of VME bus have come up with a good scheme, and the S-100 could do worse than follow their example. (For those not familiar with this standard, VME boards are based on the Eurocard form factor, being 100 x 160 mm or 233.4 x 160 mm depending just how much real estate is required for the application. The interface to the bus itself is via indirect edge connectors (DIN 41612), eliminating the unreliable and difficult-to-produce-at-home edge connectors.) I would be very interested in any comments on this — given the seeming lack of anything better other than the high-end buses Multibus-II, which requires licensing by Intel, or VME-bus itself. This is probably the way I will proceed, when I finally get round to bringing a 32-bit system up.

I. Worthington
Romsey Hampshire, England

Dear Sirs:

I hope that you bear with me as I comment on several topics from the September/October issue:

1. DRI acted as if they were trying to kill their own goose with their marketing of CP/M Plus. The documentation for installation of the unconfigured version is so poor that a thorough knowledge of CP/M 2.2 and a good network of knowledgeable friends is needed. I am not expert in hardware or software, but I would have been able to accomplish the job in 20 hours if the documentation had been adequate. Apparently several vendors failed to make the grade without the advantages which I had. Incidentally, I had in my possession a letter from DRI indicating that Westico would supply unconfigured CP/M Plus. I don't know whether this is true, but I felt little guilt in not forking over money when the realistic additional cost of the time I lost due to their lack of proper support is around $1400. I felt that if the Z80 market were to stay alive, software would need to run under CP/M Plus; however, it appears that only about 2% of software customers are looking for this.

2. Mr. Utley over simplified the business of running CP/M 2.2 programs under CP/M Plus. I have never seen a program which stuck to normal BDOS calls fail under CP/M 3.1; however there are many which don't stick to these standards. There are so many things which could be taken care of in a general purpose compatibility RSX that it could grow unreasonably large, but here are three which are missing from early public domain programs:

a. Some programs need to bypass the sector translation table. Since 128 byte sector disks are handled identically by CP/M 2.2 and 3.1, BIOS calls on these disks should be passed through. Many such programs will run find under unbanked CP/M 3.1, but not with the popular compatibility translators.

b. The method for opening files with wild cards (?,*) in the name has been covered in the literature but not included in general purpose translators.

c. Some programs, includine those linked with Microsoft FORLIB, look for the BIOS copy of the directory record when opening new extents. The method for taking care of this is analogous to the situation in (b.). This cancells out the speed advantage which unbanked CP/M + has over 2.2.

d. Some programs point to the FCB and send the file name out to the screen without terminating it with $. This causes alot more clutter under 3.1 although it was tolerable under 2.2.

It may be that if we are to look forward to a future for the Z80, we should be giving serious attention to Echelon's products. I think there is a real need for a memory banking OS and that ZCPR took too much memory to do what even unbanked CP/M + would do, but DRI seems to be deserting the market and leaving us in a situation of technical violation of copyright if we do what we need with their products.

3. Hank Kee's comments about the social rules for software distribution by public domain libraries are interesting. We need these channels, but in my mind their operators would be justified in refusing to handle contributions which carry unreasonable demands or in inviting their subscribers to vote on whether these demands are reasonable.

I have limited such requests in my offerings to requests for additional technical information, for copies of enhanced versions of my software, and for consideration of my business when buying related software. I would have appreciated being notified by those bulletin boards which were carrying my stuff and would have kept them up to date, but I have never had any answers to such requests. About the only compensation I have gained from putting things on bulletin boards is the feeling that someone might be helped by my offerings as I have been by theirs, and the ability to ask freeloaders to go find what they want on bulletin boards rather than to expect me to make up a custom program for nothing.

Jim Prince
Birmingham, MI

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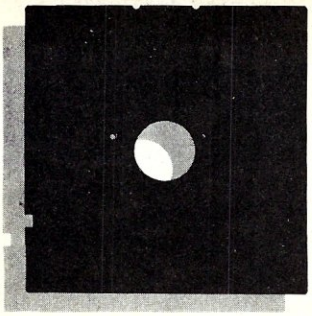

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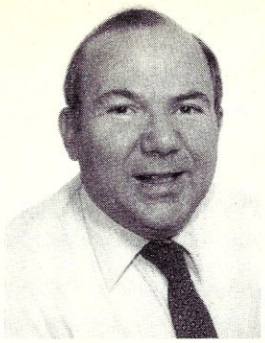

by Stephen M. Leon

INDEX TO SIG/M SOFTWARE PUBLISHED

The New York Amateur Computer Club has published an "Index to SIG/M volumes 1 through 241", prepared by Howard Vigotita. This 38 page index, by program category or file name, is available from the NYACC, Box 106, Church Street Station, NY NY 10008. Categories include different operating systems and languages, specific machines, types of utilities and specialty interests. No price is marked on the index, but if you want a copy please send them something to cover postage and printing; I would suggest $3 domestic and $4 foreign.

NEW SIG/M SOFTWARE RELEASED

Some months back, Mark Weiss, a graduate student at Syracuse University, contributed a collection of statistically oriented programs to the SIG/M library. We checked them out with an expert in the field and found that Mark's programs were really first rate. The disk, SIG/M Volume 243, called *Mark Weiss Shows His Stuff*, should be of great interest to anyone with a statistical inclination. The code is written in Turbo Pascal and therefore requires a Z-80 system. However, it should compile for MSDOS or CP/M-86. Mark also sent us his version of LIFE. We had no room for it on Volume 243, but did manage to find a spot for it on Volume 244.

LIFE appears twice in the latest releases. Professor Harold Macintosh of the University of Puebla, Mexico, again demonstrated the versatility of REC (Regular Expression Compiler) with a version of LIFE (called TORU) that runs over a period of some five days. TORU allows you to stop and start at will, so you need not be glued to the machine for that length of time.

Dr. Macintosh, winner of the Computer Hobbyist of the Year award at the 1985 Trenton Computer Festival, has two volumes in the latest releases. TORU is the feature program on Volume 246. MAZE and TOUR on Volume 245 are demonstration programs showing the use of the REC programming scheme for mazes.

The good professor also has some updated HELP material on the disks as well as another demonstration of how simple it is to put your utility routines into a single utility library and then run them directly from within the file. On my Compupro system I move a library of utilities to the RAM disk on bootup and run them out of that library throughout the session. If you don't already do that, spend five minutes with ANCI and RUN on Volume 246 to see how simple it is to make life easy.

Harry Van Tassell, CompuServe CP/M sysop, finally broke down and bought a PC Clone at the recent computer flea market run by the Amateur Computer Group of New Jersey. I stopped over at his house the following day to help him get it set up and brought over a collection of public domain utilities that I thought he would need. Included on the disk was VFILER. Rich Conn, developer of ZCPR, wrote the program for CP/M-80 and we released it on SIG/M Volume 145. Harry rewrote the code for CP/M-86, which SIG/M released on Volume 146. SIG/M included the VFILER source code in its releases.

Well, sure enough - one of the PC people took VFILER and adapted it for MS-DOS. Even gave Rich and Harry credit for the original code. However, the rewriter failed to include the source code and sure enough - it does not work on Harry's composite video monitor. No sense rehashing the demon *freeware* arguments again, but the fact is that by encouraging people to have their hands out for freeware donations, we discourage people who are not seeking money from supplying the source code.

Some other good people have made excellent contributions to SIG/M this month. Gerry Edgar, a frequent contributor, has donated EPRO - Small Prolog (Volume 242). The actual code takes up only 6K and requires a Z-80 to run. M-80 source code is included as is a compiler written in Prolog. The program comes with comprehensive documentation files and references so that with a little effort you can become familiar with the language. Sample code is provided to help you learn.

On the same volume (242) Garry Womack has released, for public domain distribution, a former commercial program - FIP (File Interchange Program). It also requires a Z-80 and, like most programs in the commercial world, does not include source code. A full manual is on the disk. It is a fairly well done file manipulator similar to SWEEP or VFILER, but with enough in the way of features to make it interesting. Such features include file comparison, attribute changing, display of deleted directory entries, wildcard renaming, etc. Also on the disk is Garry's SANDR (Search and Replace) which does just that for binary or ASCII strings.

Adam Fritz has contributed two major works on SIG/M Volume 244. His Whetstone Benchmarks for a variety of languages emphasize integer or floating math, simple or subscripted variables and subprogram or function library routine calls. The languages covered included ALGOL, FORTRAN, BASIC, C, PASCAL and ADA. He also has provided programs to convert LINPAK single precision general system routines. Very technical, very specific - but very useful for those who have a need for it.

Steve Leon is the SIG/M Disk Editor. In other words, he is the person who assembles, compiles and edits all the of the SIG/M public domain software disks. Thus, he speaks with the greatest authority as to what is going on in the SIG/M public domain software area.

TCF-86 IS COMING!

The 11th annual Trenton Computer Festival will be held on Saturday and Sunday, April 19th and 20th. This year we will expand the seminar schedule to cover both Saturday and Sunday. Just about everybody comes to Trenton. We have even invited Irv Hoff!

TCF is run by five computer clubs (including the Amateur Computer Group of New Jersey). In other words it is a show run by computer hobbyists for computer hobbyists.

TCF is the oldest of the computer shows (now in its 11th year) and the biggest and best non-commercial computer event of the year, with a huge out-door computer flea market that covers acres and acres. There is also a large indoor commercial exhibit area, speakers, presentations, user group meetings, and prizes. Sol Libes usually waits for TCF to buy stuff to get the best prices. Incidentally, Sol will be the Master of Ceremonies at the Saturday night banquet and

Phil Lemons, Editor of Byte magazine, will be the featured speaker. You will also be able to personally meet many of the M/SJ author's who regularly attend TCF....guys like Bill Wong, Hank Kee, Charley Strom, Mike Guttman, Dave Hardy, Don Libes, Randy Reitz, Bruce Ratoff and me.Steve Ciarcia (of Byte fame) says he "never misses TCF." We will have more information about TCF in the next issue of M/SJ.

If you would like to be a speaker at Trenton please contact Bob Todd, 1121 Briarwood, Bensalem, PA 19141. The speaker deadline is January 31st so please try to sign up. Do your presentation with an audience ranging from neophytes to founding fathers. Quite a challenge and quite a show!

ORDERING THE NEW SIG/M RELEASES

SIG/M Volumes are available on 8" SS SD Disks for $6.00 each ($9.00 foreign) directly from SIG/M, Box 97, Iselin, NJ 08030. Printed catalogs (40 pages) are $4.00 each ($5.00 foreign). Disks in a variety of formats may be obtained through the worldwide SIG/M distribution network (published in the September/October 1985 issue of M/SJ). The distributor list is also included with the printed catalog.

A disk version of the catalog (Volume 00) is available for $6.00. Many bulletin boards have the software for downloading and most new releases on available on the CP/M Sig on Compuserve. There are also a number of commercial companies which distribute SIG/M software on a sale or a rental basis. For Apple CP/M users, the Philadelphia Area Computer Society, Box 477, Kulpsville, PA 19442, has most of the SIG/M volumes in Apple II format.

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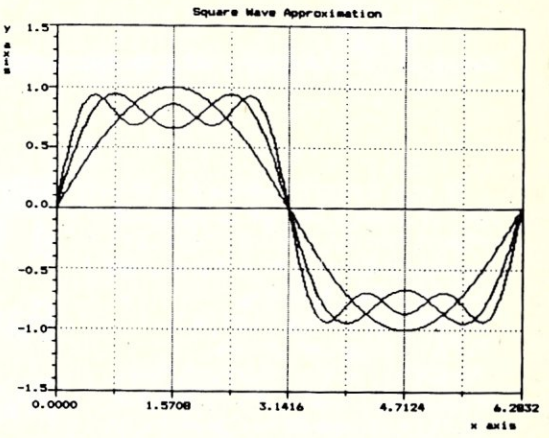

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TERMS: We ship via first class mail. The above prices include domestic shipping and handling. Orders outside USA require additional $5.00 for postage. N.Y. residents add state sales tax. When ordering you MUST state your computer and printer make and model. We support MS-DOS (PC-DOS) version 2.0 or later on computers with at least 192k RAM, and CP/M-80 version 2.2 or later on Z80 computers (other than modified Apples) supporting a TPA of at least 54k (requires 64k of RAM). Most soft-sector disk formats are available. (If you can read several formats, please send us a list.) GRAF 3.0 works with any printer fully compatible with one of the following: Epson FX, RX, LX, MX (with GRAFTRAX), or LQ-1500; C. Itoh Prowriter; NEC 8023A; Star Micronics Gemini 10X, 15X, SG-10, SG-15; IBM Graphics Printer; Okidata 192, and earlier Okidata models equipped with the "IBM Plug 'n' Play" chips. (If you have an Okidata printer, other than the 192, the Plug 'n' Play chips are *required*!)

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CP/M DRI MS-DOS MicroSoft

Volume 242 EPRO (Small Prolog) by Gerald Edgar
File Interchange, Search & Replace
released September 20, 1985

EPRO	.LBR	103K	Z80 small Prolog with documentation
FIP	.LBR	76K	Z80 screen file manager with doc
SANDR	.COM	2K	search and replace strings - 8085
SANDR	.DOC	8K	/

Volume 243 Mark Weiss Shows His Stuff
Random Numbers, etc. in Turbo Pascal
released September 20, 1985

AUTOCOMP	.COM	10K	probabilities for complete set acquisition
AUTOCOMP	.PQS	3K	in the collectors problem
CHIPS	.COM	21K	a game for people who like to play
CHIPS1	.PQS	6K	detective - based on probability
CHIPS2	.PQS	10K	/
CHISQR	.COM	10K	chi-square test of random number generation
CHISQR	.PQS	2K	/
COLLECT	.COM	10K	probability of having a complete set given
COLLECT	.PQS	3K	the number in set and number acquired
DEMO1	.LQG	3K	/
DEMO2	.LQG	3K	/
GAMMAFIT	.COM	14K	fits gamma probability density function to
GAMMAFIT	.PQS	6K	a datafile listing number from 0 to 100
GETNAME	.PRO	1K	(support file)
HISCORE	.LQG	6K	/
LSTSQR	.COM	12K	linear least square fits
LSTSQR	.PQS	3K	/
NEAR	.COM	11K	a new statistical test developed by Mark
NEAR	.PQS	3K	/
NORMAL2	.BAS	2K	MBASIC best estimate of the true mean
PIAPPROX	.COM	10K	pi approximation - circle in a square -
PIAPPROX	.PQS	3K	is a random point a boundary?
RUNSTEST	.COM	15K	degree of independence of successively
RUNSTEST	.PQS	8K	generated values of random number gen.
VISCOS1	.DAT	1K	(support file)
XRD	.COM	14K	resulting angles and d-spacing of x-ray
XRD	.PQS	5K	diffraction powder pattern line positions
CONTROL	.XQD	1K	/

Volume 244 Whetstone Benchmarks and Linpack Conversions
by Adam T. Fritz
released September 20, 1985

LPAK11	.DOC	19K	converts LINPAK single precision general
LPAK11	.ADD	10K	system routines to Pascal and C; provides
LPAK10-F	.LQR	22K	drivers to apply and demonstrate routines
LPAK11-C	.LQR	23K	and discusses results. In Fortran, C and
LPAK11-T	.LQR	24K	Turbo Pascal.
WSTONE12	.LBR	54K	Whetstone benchmarks
LIFE	.COM	18K	new version in Turbo Pascal
LIFE	.PAS	13K	/

Volume 245 Convert Programming - MAZE and TOUR
Universidad Autonoma de Puebla
released September 20, 1985

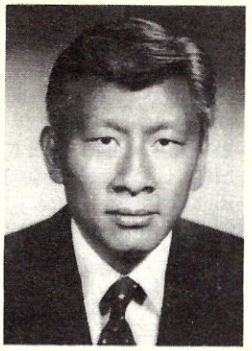
FYNDE	.COM	5K	locate patterns in all kinds of files
HJELP	.COM	13K	HELP files with embedded programs
HJELP	.LBR	45K	everything to use and update HJELP
MAZE	.LBR	41K	sample CNVRT programs to run mazes
RUN	.COM	4K	execute programs where ever they are
TOUR	.LBR	94K	collection of maze programs

Volume 246 Convert Programming - LIFE (Toru)
Universidad Autonoma de Puebla
released September 20, 1985

ANCI	.LBR	30K	library of ancillary programs
CNVLIB	.REC	7K	Cnvrt runtime library
CNVSM	.REC	7K	compact Cnvrt compiler
HJELP	.COM	13K	read HELP files (including binary material)
RUN	.COM	4K	executes files - even from libraries
TORU	.LBR	156K	Convert examples of LIFE

PC/Blue Report

by Hank Kee



In a prior column, I made note of how one can amass a very useful collection of software from the public-domain and user-supported software libraries. For example, I had selected the following:

PC-WRITE: a word processor
WPK : a processor for kids
PC-CALC : an electronic spreadsheet
FREECALC: an electronic spreadsheet
PC-FILE : a database management system
PC-DBMS : a database management system
3BY5 : a database management system
QMODEM : a communications package (XMODEM)
PCTALK3 : a communications package (XMODEM)
PCPG : a PC picture graphics

This month I will review some of my favorite utilities in the PC/Blue library (all are on Volume 151). Not only do I use them often, but many are not generally commercially available.

VFILER was originally written and submitted to the SIG/M library by Harry Van Tassel. This is a very flexible file-manipulation utility designed for tagging and untagging files for group operations. For example, a series of unrelated but tagged files can be deleted with a single ERASE command. When this software was originally made available for CP/M systems, it contained source code, but subsequent versions do not include the modified source.

PCSWEEP is similar to VFILER, but in addition to the essential functionality of VFILER, PCSWEEP has file-attribute handling capabilities. File squeezing and unsqueezing functions are also included. The program is user supported and a donation is unabashedly requested.

Have you ever wanted to modify the date and time stamp of a given file? If you look at the files in a PC-DOS diskette, they all have uniform dates and times. For those of us perfectionists, FDATE will enable modification of the date and time, one file at a time. The process is done one file at a time. It would have been nicer if the source code could have been available so that a wildcard option could be included, if desired. If you are interested in blanking out the date and time stamp on a DIR command, this can be done by setting the date and time to 00/00/80 and 00:00:00, respectively.

A Look At My Favorite Public Domain Utility Programs

RENDIR will permit the user to change the name of a subcatalog. This ultility saves you from the tedious routine of having to create a new separate subdirectory and then transferring all the files from the old to the new subcatalog.

LU is a very popular library utility in the SIG/M library. LU allows one to put all related files into one compressed file for modem transmission or archiving purposes. LU.COM, the original conversion for PC-DOS, has been superceded by LAR.EXE. The functions are similar to those of the CP/M version. Also useful are SQ and USQ, which can squeeze and unsqueeze a file in MS-DOS or PC-DOS. I had been using NSQ and NUSQ for a long time, but these utilities were developed by frequent users of bulletin board systems. Happily, SQ and USQ eliminate lengthy transmission times required by NSQ and NUSQ. A new utility combining LU, SQ, USQ, and then some, is now available. It is called ARC for archive. It was written and made available by System Enhancement Associates, 21 New Street, Wayne, NJ 07470.

ARC will create a library file, as well as preserve the original date and time stamp. In addition, it will automatically squeeze down the files more efficiently than SQ. Upon extraction, it will, of course, unsqueeze the individual files. On top of all this, it will also sort the files in alphabetic sequence. The great value of this program lies in the large number of useful options that are available.

Usage:

```
ARC {aumdxerplvt}[bwn] <archive>
  [<filename> . . .]
```

Where:

a,u = add files to archive
m = move files to archive
d = delete files from archive
x,e = extract files from archive
r = run files from archive
p = copy files from archive to stdout
l = list files in archive
v = verbose listing of files in archive
t = test archive integrity
c = convert entry to new packing method
b = retain backup copy of archive
w = suppress warning messages
n = suppress notes and comments

Editor's Note: Hank Kee is the librarian for the PC/Blue public domain software library. He is the person who collects, assembles, and checks all the software issued by PC/Blue and then compiles and edits them into the released volumes.

As I write this column, I am reminded of an additional process I go through to strip off the high bits of Wordstar output. The program I use is called WSCONV.EXE. Like most people, I use Wordstar only through force of habit; there are better word processors available. As I receive many program submissions with documentation in other than Wordstar format, WSCONV makes it easy for me to handle this output, as well as produce text that can be accepted by other systems.

Yes, the PC/Blue directory listing is automated. John Rath, of the ACG-NJ, having pity on my editorial labors for the SIG/M library, developed a program call CRCBUILD. This program will set up the shell-catalog listing with the names, sizes, and CRC's of all the files. Of course, the file descriptions have to be entered manually, nevertheless, this utility is a real time saver. Since various special interest groups have asked, an MS-DOS version of the program

Copies of the PC/Blue printed software directory can be ordered from Micro/Systems Journal, Box 1192, Mountainside NJ 07092 ($4 U.S, Canada & Mexico; $6 foreign).

PC/Blue disks are available from the New York Amateur Computer Club, Inc., Box 106, Church Street Station, NY NY 10008. Price is $7 per volume which includes media, postage, and handling. On foreign orders, please add $2 per disk.

has been written by Howard Vigorita of the NYACC.

Though there are many different versions of SDIR, their basic formats and outputs are all similar to the version of SDIR in the SIG/M library. However, not all of these directory programs are safe to use. For example, a malacious version of a virtual extended directory program called VDIR has been making the rounds of unsuspecting bulletin-board systems. This program will wipe out your directory permanently. Let this be a sober reminder to all who download from bulletin-board systems. The SYSOP does not always have the opportunity to check out each uploaded file. If you download any file, it should be checked in such a way that the main body of your files are not affected.

There are many more utilities, which I will comment on in a future column. As it is impossible, in this limited space to give a detailed review on all such utilities, I have and will describe only those I use daily.

NEW PC/BLUE RELEASES

During the past two months, I have released several new volumes to the PC/Blue library. They are:

```
Vols 148/149 Potomac Pacific Engineering (2 diskettes)
             database/spreadsheet/expert system

Vol 150  Flow System Organizer
         Visible Pascal (interpretive and interactive)

Vol 151  Miscellaneous utilities
ADDRIVE    software reset - floppy switch configuration
ALUSQ11    unsqueeze .?Q? files
AXX        "Autodex" - file manager
BIOSDATE   BIOS ROM date display
CED        command editor
CHKDIR     subdirectory CHKDSK
COPYPC     DISKCOPY handling bad tracks
DIPSET     displays PC switch settings
DIR-X      expanded directory
DISPNDX    displays dBase II/III index structures
DISKSQ     squeeze entire diskette
DISKUNSQ   unsqueeze entire diskette
EQUIP102   equipment display v1.02
KBFIX22    keyboard enhancer v2.2
LAR14      library update program
LDEVS      displays I/O drivers
LIST54     ASCII screen editor
RDIR       rename file
RENDIR     rename subdirectory
RULER2     slide screen column ruler up/down
TABS19     TAB utility add/remove tabs from ASCII files
WASH       file manager
WINDOW     3 "window" background utility
WS2DOS     converts Wordstar text

Vol 152  Confidant v2.0 Encryption Program
         Symphony Macro Conversion Aid &
         Range Input Command

Vol 153  Fun & Games
     Aardvark  Abm       Bowling   Brick
     Bugs      Chsong    Fxlable   Keno
     Kidnap    Lablmakr  Lease     Memo
     Monopoly  Qubert    Spacwar   Starlane
     Stocks    Stress    Tem-Ins   Temple

Vol 154  Small DataBase - SDB v2.0
         Ron Cain's Small-C:PC v1.1

Vol 155/156   RBBS-PC v12.5b (2 diskettes)

Vol 157  Public Domain PROLOG
             by Automata Design Associates

Vols 158/159   AnalytiCalc-86 v18-04e (2 disks)
               MS-DOS Integrated Spreadsheet

Volume 160     Genealogy ON DISPLAY version 3.1
```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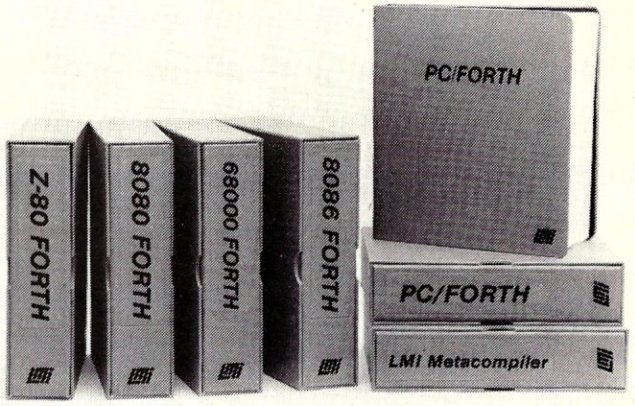

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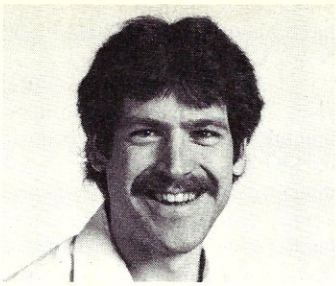
The C Forum



by Don Libes

Most people are familiar with C compilers. You hand the compiler your code, it compiles and returns an object module (or a lot of error messages). The linker is then used to combine the object files and any libraries into an executable program (when you get the opportunity to read more error messages). After all this is done, you get your last chance for errors when you run your program.

If the program doesn't behave as desired (either by acting oddly or bombing), you can change the source code (adding printfs) and recompile it, starting the whole circle again. This could be called the *edit-compile-link-run-repeat-the-whole-mess style of programming*.

This can be especially painful, because just a simple change like adding a printf still forces the source file to be recompiled and everything to be relinked. This can take a long time for large programs.

Sometimes, the program doesn't even compile or link, leading to an *edit-compile-loop*. Assuming that it does compile but doesn't run correctly, we can run the program under control of the debugger. This means we can set breakpoints and when it is stopped look at variables. Look at the stack. Let the program step through a couple of statements. Look at some pointers. Trace the pointers as they go through many levels of indirection (this is always fun), finally ending up pointing to oblivion.

Symbolic debuggers work on the C-statement level rather than the assembler level. You can step through lines corresponding directly to your original program. You can evaluate C expressions or call subroutines. The nicest one I've seen (dbx from 4.2BSD UNIX) can print out complete structures formatted appropriately for their types.

All debuggers will let you change variable values, but frequently that isn't very useful. You need to change the code or unwind the stack a bit and continue on. I don't know of any debuggers that are this capable.

Indeed, no debugger holds a candle to a good C interpreter. An interpreter bypasses the compile step and often the edit step, also. What's left? Run, run, run! Yeah!

C Interpreters

INTERPRETERS VS COMPILERS

Let's review the difference between a compiler and an interpreter. Bear in mind that these are generalizations and differ from implementation to implementation.

A compiler takes the source program and makes several passes over it, typically including scanning, parsing, (optional optimization,) code generation, (more optional code optimization) and linking.

Because of interdependencies in the code, it is much easier to handle one phase at a time. Changing (i.e. fixing) the compiler is easier because impact on other phases is isolated. Machine dependencies can be isolated to only the code generation phase.

The result for the user is that compilers tend to be slow, because of all these phases and also due to the amount of optimization they do. Also, you must have a complete program even to test out portions of an algorithm since the compiler wants to resolve all references.

On the other hand, an interpreter resides in memory while the program is actually running. At each step, it takes the next source statement and performs all the phases at once, thereby executing it. In reality, an interpreter typically performs some of the phases while reading the program in, since many errors can be detected during a simple scan of the program. This is known as *incremental compilation* but the term interpreter is used to drive home to the buyer of such software that it behaves much more like an interpreter.

C INTERPRETER ADVANTAGES

Not only do interpreters work in ways that seem closer to the ways humans think, but they are more interactive, reporting errors very quickly after they can be detected. Further speedup is gained by having the interpreter and editor be co-resident in memory, and when an error is detected or fixed, control is passed very quickly to the other. Finally, interpreters place little emphasis on optimization under the theory that it is pointless, since you are only debugging anyway.

The end result is that the user does not have to wait for a program to be recompiled and relinked in order to make a small program change. Indeed, program fragments can be tested directly, so that the programmer does not have to waste time building up a small skeleton only to find out that his approach is completely wrong.

Some C interpreters are deeply integrated with an editor so that they can leave the cursor right at the spot where the error was detected as soon as one has been detected. Since this is done so quickly, there is less emphasis on being able to continue compiling in the fact of errors, a continual problem in compiler building. The user is satisfied with one error at a time, since the interpreter picks up just where it has left off.

But what about runtimes? Well, that is where all the interpreters cost. Some interpreters are actually quite speedy, achieving times that are only several times as great as that of compiled code. The slowest interpreters are quite slow, however, and for large programs, verging on the unbearable.

What makes all this livable is the theory that you don't really care how long programs take to execute while you're developing them. (Although thats what people originally theorized about compilers, and yet, no one wants to put up with a slow compiler.)

When you are satisfied that the program performs correctly, you then compile the program with an optimizing compiler. The result is that you have the best of both worlds: a development system that is extremely fast and flexible, and a means for turning out fast code in production form.

THE DISADVANTAGES OF C INTERPRETERS

The drawbacks to working in this manner are few but worth mentioning.

The most important is that the interpreter and compiler can behave differently. There are dark corners of the language, that are not completely defined, even by the new C *standard*. Implementation dependencies

(such as language extensions) can be a problem. While all of the interpreters and compilers are *full K&R* they are not in conformance with many extensions currently expected to be in the C standard and they may differ in disjointed ways. Optimization nuances may cause a compiled program to behave differently than an interpreted one.

There are, of course, ways in which you would want the interpreter to behave differently from the compiler. For example, exit() normally returns to the operating system, but while debugging, it should behave as a return to the interpreter.

Another drawback is that the interpreter will need to be resident while you run your programs along with a lot of extra baggage, such as symbol tables, type and usage information, etc. The result is that you will not be able to interpret programs that are as large as ones that you can compile and run.

The interpreter may do things that get in your way, such as using interrupts or memory that you want to use, or using the screen when you are debugging a graphics program. Of course, a debugger is no different in this respect.

Lastly, you can expect an interpreted program to be (much) slower than a compiled one.

CONCLUSION

When it comes to the point of actually testing running code, a great deal of time is spent making minor changes and then waiting while it is recompiled so that you can test it again. For example, you might discover that you have passed the wrong variable as a parameter or that your index is off by one. Or your might want to try a subtle change in your algorithm. These are all minor modifications that require you edit your original code, recompile it and then link the whole mess together again.

Being able to stop code at the point of error and modify it or evaluate arbitrary C statements and expressions without constructing a main() and losing your context leads to a whole new style of programming. It brings C programmers to a more modern way of programming. Interactively. Its about time.

Programming in this manner has been available to Lisp and APL programmers for 20 years and to a lesser extent for several other languages. While we slowly get access to C interpreters, new programming environments for these other languages are being refined to make use of even more effective tools, such as graphical display of algorithms and data structures, language-directed editors and program verifiers. These will give C yet another lease on life in the next few years. I can't wait.

Don Libes is a computer scientist working in the Washington DC area. He works on artificial intelligence in robot control systems. He is also the son of Lennie and Sol Libes.

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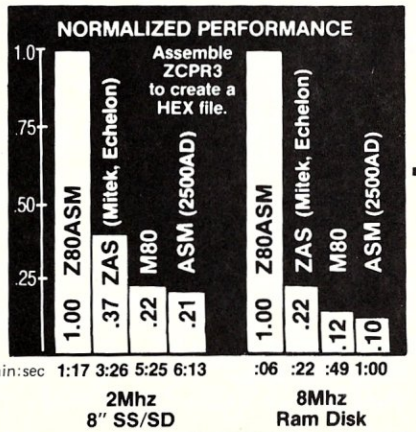

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Turbo Pascal Corner

by David W. Carroll

This column features tips and techniques for using Turbo Pascal productively on MS/PC-DOS and CP/M microcomputer systems. It discusses typical problems and their solutions. Reader suggestions, comments, and questions are encouraged. Address them to: Turbo Pascal Corner, Box 699, Pine Grove CA 95665.

Over 400,000 copies of Turbo Pascal have been sold - over 80 percent to MS/PC-DOS users. This has created a sizeable *after-market* for commercial Turbo tools and utilities - which both small and large software vendors have moved to capitalize on.

These products can be roughly broken down into the following catagories:

* Programmer tool kits (ready made source code modules)
* Linkable modules (compiled)
* Program Generators (create Turbo source code)
* Utilities (listers, formatters, cross-referencers)
* Ready-to-go programs
* Training aids

I will discuss a few of the products available in each category in the following sections. A vendor list is provided at the end of the article.

TOOLS

Perhaps the largest category and most useful programs are the programmer toolkits. These typically consist of a number of procedures and functions each of which performs a useful process, like testing printer status, changing the logged drive, getting the date or time, and so on. Of course, many of these processes have been created in the public domain, but these commercial packages have the advantage of a consistent calling protocol and usually provide some level of documentation and some even provide an example program using each procedure or function.

Turbo DataBase Toolbox $54.95
Borland International
Book-Disk package providing routines for building and sorting databases.

Turbo Graphix Toolbox $54.95
Borland International
Book-Disk package which provides using screen graphics and animation routines.

Turbo Pascal Support & Enhancement Products.

AEFTOOLS $29.95
Allen, Emerson & Franklin Inc.
Over 100 utility modules for inclusion in your TP programs. Well written and commented source code. Doc file but no manual. Great value.

Training Wheels for Turbo Pascal $25.00
by Robert E. Brown
Landmark Software
Features 74 utility modules and demo programs for use with Turbo Pascal programs. Large 8.5" x 11" (76 page) manual included. Great value.

Turbo Graphics $39.95
by Mark Edwards
Diversified Educational Enterprises
Complete set of high speed graphics routines and binary files foruse with Turbo Pascal - 24 files and large manual (60 pages plus listings).

TURBO POWER TOOLS $99.95
Blaise Computing
This set of utilities includes an excellent manual with over 140-8.5"x11" pages of documentation and three diskettes. This package has virtually everything you could need. The routines include the following:
-String functions
-Screen handling
-Window management
-Keyboard control
-DOS utilities
-File handling
-Directory maintenance
-Memory maintenance
-Program control
-Interrupt service routine support

TURBO ASYNCH $99.95
Blaise Computing
This set of utilities provides asynchronous communications capabilities in your Turbo Pascal application programs. They will drive any asynchronous device via the RS232 COM ports, like printers, plotters, modems and other computers. A complete manual is provided. Features include:
-Written in assembly code (source included)
-Initialization of COM ports
-Interrupt processing
-Data transfer between circular queues and ports
-Simultaneous buffered input and output to both COM ports
-Transmission speeds up to 9600 baud
-Input and output queues of any size

SUPER TOOLS LIBRARY $95.00
Paragon Courseware

-WINDOW MANAGEMENT
Provides Turbo routines for advanced windowing capabilities.
Features:
-Open several windows simultaneously
-Store data in overlapping windows
-Store environment of each window (color, cursor, etc.)
-remove and redisplay windows (pop-up)
-cursor control within each window
-Window disk libraries supported
-Supports both color and monochrome
-Can access video RAM directly (without "snow") for maximum speed, or use BIOS video interrupts for maximum compatibility.

-SYSTEM AND FILE INFORMATION PACKAGE
These routines provde data on the current system environment.
-Determine run-time hardware (i.e. display card type, number and kind of disk drives, amount of RAM, number of ports, and whether or not a clock exists.
-Determine if a drive is ready, without the DOS error "Abort, Re-try, Ignore?". Find disk free space. Set default drive. Get and change file attributes.

-MATH EXPRESSION EVALUATOR
This routine is a single function which accepts a mathematical expression in the form of a Turbo Pascal string. After syntax verification, the expression is evaluated and a REAL type result is returned. All math functions and operatons are supported.

FASTSCREEN FOR TURBO PASCAL $30.00
Technisoft
FASTSCREEN adds fast screen output capability to your Turbo Pascal programs. Display a full screen or window almost instantly. Read a full screen or window containing multiple input fields with a single procedure call. Give your programs a clean, professional look. Inline assembler and Turbo routines, all source included.

TURBO PASCAL LIBRARY 3.0 $25.00
Success Press
60 useful routines including: pop-up windows, run DOS, DOS commands and other programs from your Turbo programs. Get display mode, use dual displays, get free space, set or clear attributes, etc. Heavily commented source code with a demo program for each routine. Great value.

Pascal's Friend $39.95
J.S. Computing
Four include files and an application program for IBM PC which provide BIOS/DOS access, screen and keyboard access, calendar functions, and 1-2-3 like-menus. The application is a daily reminder program.

EXTERNAL MODULES

A few products include object code modules which can be linked to the user's program as external procedures to perform operations which are too time critical for anything but assembly code (some screen operations, communications I/O, etc.).

Turbo-Plus $29.95
Nostradamus
A library of procedures crafted in assembly language anddesigned to enhance Turbo Pascal versions 2.0 and 3.0. These procedures are extremely fast and combine with user programs as external procedures. Great value. Features include:
-Display Mapping without flicker or snow
-Field input screens
-Screen read and write
-Advanced keyboard control
-RAM Window for debugging
-Enhanced file I/O using file handles
-Pop-up Turbo Reference Guide (memory resident)

PROGRAM GENERATORS

A new group of products has appeared recently which actually generate Turbo Pascal source code programs, which may then be run stand-alone or combined with user programs. These programs include a database program generator, several entry screen generators, and even a compiler (parser) generator.

GTP (Generate Turbo Program) $99.95
Allen, Emerson & Franklin Inc.
Database program generator creates Turbo source code for data base applications. Makes input screens and file I/O modules. Manual and source code included.

Screenmaker US$34.95 plus $4.00 shipping
Stampede Software Designs
Develop a library of up to 9 input screens per program with full editing and help features. Source included.

Forms Defintion System US$49.95
CompuCam
Create data screens and input forms. Allows extensive data editing. Source included.

Turbo Screen $49.95
Pascom Computing
Create up to 99 screens and save to disk. Includes screen editor, collator, and code generator. Source not included.

Screen Sculptor $125.00
Software Bottling Co.
Advanced screen generator creates program code from "image" of screen you design.

QParser $400.00
QCAD Systems
Compiler program generator - makes TP source code for compiler front-end from a syntax rule table. Sample C and Pascal compiler syntaxes included. Includes TP 3.0. Huge manual.

UTILITIES

Utility programs for Turbo programmers are also quite numerous, and include a number of program listers, cross-referencers, and source code formatters. Other utilities include code timers, structure analysers, and optimizers.

TPF (Turbo Print Formatter) $29.95
Allen, Emerson & Franklin Inc.
Utility that allows using embedded print commands in TP Source programs for printer control.

PROGRAMMERS UTILITIES $95.00
Turbo Power
Especially for power users of Turbo Pascal. Includes a bound manual, three diskettes which include the source plus compiled versions, and quick reference chart. The utilities include the following:

-PRETTY PRINTER: Standardize capitalization, indentation, and spacing of code.

-PROGRAM STRUCTURE ANALYZER: Find subtle problems the compiler doesn't: uninitialized and unused variables, modified value parameters, "sneaky" variable modification, redefined standard identifiers. Also generates complete variable cross reference and program hierarchy diagram.

-EXECUTION TIMER: Summary of time spent in each procedure /function of the program, accurate to within 200 microseconds. Counts number of calls to each subprogram and is fully automatic.

-EXECUTION PROFILER: Graphic profile or where program spends its time. Interactive, easy to use. Identify weak code.

-COMMAND REPEATER: Go beyond MS DOS batch files to combine a powerful text parser with general purpose command execution capability. Use to copy, print, delete across subdirectories.

-PATTERN REPLACER: Find and replace versatile regular expression patterns in any text file. Supports nesting, alternation, tagged words and more. Over dozen programmer's applications included.

-DIFFERENCE FINDER: Find differences between two text files, and optionally create an EDLIN script which rebuilds one from the other. Disregard white space, case, arbitrary characters and Pascal comments, if desired.

- SUPER DIRECTORY: Replace PCDOS DIR command with extended pattern matching, sorting capability, hidden file display, date filtering, and more.

- FILE FINDER: Locate files anywhere in the subdirectory tree and access with a single keystroke. Display the subdirectory tree graphically.

Turbo Utilities $20.00
ESD Software Co.
Includes a lister, formatter, and cross-referencer for Turbo Pascal programs.

TurboRef $49.95
Gracon Services
Cross-reference and listing utility for Turbo Pascal source programs. Source included.

ListPascal $19.95
Karl Gerhard
Versatile List program for Turbo like Borland's "lost" TLIST.

Tidy $49.00
Major Software
Turbo or Microsoft Pascal source code formatter utility. No source included.

PascalPac $69.00
Major Software
Features four utilities for Pascal programmers:
X-REF creates a cross reference table
X-RAY browses cross-ref table and source code at same time
X-PRNT is a versitile listing program
X-PEEK browses programs or text files
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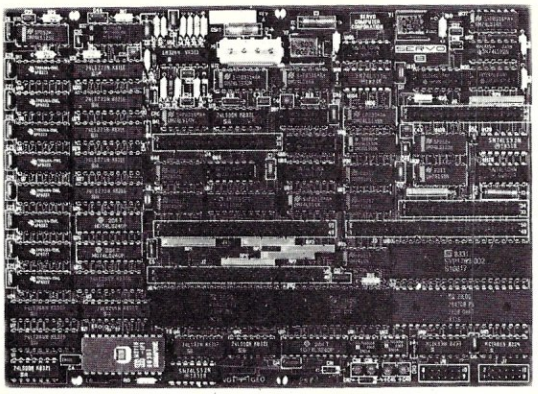

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PROGRAM PACKS

Borland has pioneered the area of ready-to-go programs including source code. Several "program packs" are being offered.

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Turbo Editor Toolbox $69.95
Borland International
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TRAINING AIDS

The final area of Turbo products includes training aids, tutorials, and books. Borland was first here too, with its *Turbo Tutor* package. Four books on Turbo Pascal have been released to date and at least two more are scheduled to be out by Spring.

Introducton to Turbo Pascal $14.95 paperback, 300 pages
Author: Douglas S. Stivison
Publisher: SYBEX, Inc
Balanced overall coverage of Turbo Pascal for both new and experienced programmers. Many useful examples and routines included in the text.

Using Turbo Pascal $19.95 paperback, 350 pages
Author: Steve Wood
Publisher: Osborne McGraw-Hill
Turbo Pascal for the experienced programmer. The book discusses program design and Pascal's syntax requirements, develops a useful application program, and gives an overview of some of the advanced utilities and features available with Turbo Pascal.

Complete Turbo Pascal $19.95, 464 pages
Author: Jeff Duntemann, Tech Editor for PC Tech Journal
Publisher: Scott, Foresman & Co.
This book was designed for programmers new to Pascal. It includes a complete Tutorial on the Pascal language, and detailed instructions on installing, modifying, and using TurboPascal on your IBM PC, compatible, or CP/M computer.

Programming with Turbo Pascal $34.95 300 pages
Author: David W. Carroll
Publisher: BYTE/McGraw-Hill
Book-disk includes demo Borland Turbo Pascal compiler, 3 utilities and over 70 working programs on disk.

Turbo Tutor $34.95
Borland International
Book-Disk package which highlights hard to understand concepts in Turbo Pascal. Both sample utilities and example programs are provided on diskette.

Pascal Tutor $59.95
Gamma Software
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TOOLS, Utilities

A library of some 600 Turbo Pascal public domain programs are available 24 hours a day for free downloading on the "High Sierra RBBS" system at 209/296-3534 operated by the author.

David W. Carroll is a freelance writer and computer consultant living in the Sierra Nevada foothills near Sacramento, California. He is the author of "Telecommunications with the IBM PCjr" co-published by Micro Text/Prentice Hall and "Programming with Turbo Pascal" co-published by Micro Text/McGraw-Hill.

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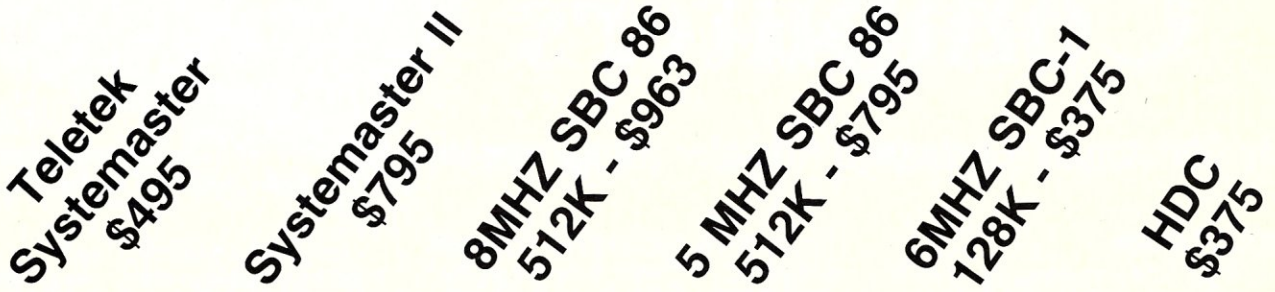

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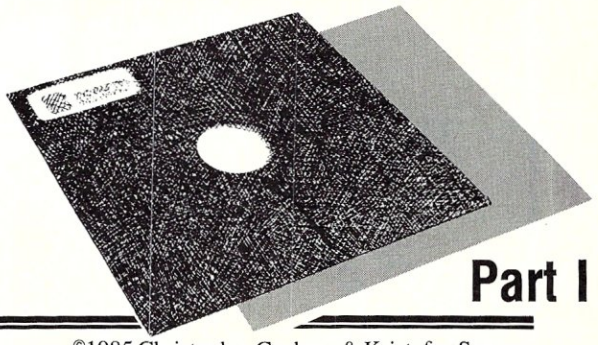
Implementing PC-DOS on Non-IBM Compatible Computers



Part I

By Christopher Cochran & Kristofer Sweger

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INTRODUCTION

When IBM introduced the IBM Personal Computer with the MS-DOS operating system, the battle between CP/M-86 and MS-DOS was decided. At the time, MS-DOS had only a slight edge over CP/M-86 in functionality, its main improvements being dated files and faster disk access. Since then, Microsoft has expanded upon the original operating system to provide some truly exceptional capabilities for a microcomputer operating system. These include tree-structured file systems, installable device drivers, redirection of console input and output to other devices or files, piping the output stream of one program to the input stream of another, and greater disk capacity.

A recent study by Input, a Mountain View CA market research firm, projects that by 1990, PC-DOS or MS-DOS will be used on 74 percent of business microcomputers, CP/M on only one percent, and other proprietary operating systems (i.e. Unix or manufacturers' systems) will account for the remaining 25 percent. In 1984, comparable figures were 33 percent PC-DOS, 13 percent CP/M and 54 percent other. If this forecast is accurate, the market share for PC-DOS will more than double, CP/M will almost vanish, and other operating systems will lose about half their market share.

Because MS-DOS is now the operating system chosen by most software developers, you will need to have MS-DOS on your computer to run the majority of 8086 (and 8088) software being written today. So you skip down to your local computer store with $65 to buy a copy of MS-DOS for your nice, fast S-100 10 Mhz 8086 computer, only to discover that you can only buy it for an IBM-PC or PC-compatible! You see, MS-DOS is distributed only for hardware whose manufacturers have obtained a license to sell MS-DOS for their specific equipment. For most low unit-quantity computers the cost per copy of the license agreement with Microsoft plus BIOS customization has been prohibitive. Furthermore, until now there has been no publicly documented procedure for porting MS-DOS to these machines. Your only choice was to enter into a licensing agreement with Microsoft, which, if they will even talk to you, is rather expensive for a one-time port.

The purpose of this article is to explain how you go about modifying an implementation of MS-DOS designed for another computer so that it correctly executes on yours. If you embark on such a project, be sure that you purchase a copy of MS-DOS so that you have the legal right to use and modify it without violating the law.

FEASIBILITY OF THIS PROJECT FOR AN INDIVIDUAL USER

Porting IBM PC-DOS to an arbitrary computer is not a simple task to be done in a few leisurely afternoons or evenings. It is debatable whether this project is even worthwhile at all for a single installation, given the amount of work it requires. To begin with, the following equipment, software tools and expertise are prerequisite for a successful implementation:

- A development computer with an 8086, 80286 or 8088 CPU, 256k bytes or more of main memory, one or more floppy disk drives, a video console and some sort of hard copy device.
- If your development computer can't read soft-sectored 5.25" PC-DOS diskettes, you will need access to an IBM-PC or other computer running PC-DOS. This is necessary to extract the DOS system files from the IBM release 5.25" floppy disks. Some means must then be provided to transfer these files to your development system via a serial or parallel port which can transfer 8-bit binary data.
- Necessary software tools include an 8086 assembler, disassembler, machine code debugger, and editor. All of these are available under any system that already has CP/M-86 (or CCP/M, MP/M-86), MS-DOS (or PC-DOS), or RMX up and running. You would be well advised to also have a good high-level language on hand so that you can develop, as needed, various source code scanners and filters to assist the development process.
- You should have experience in assembly language programming and debugging. Operating system work is notoriously difficult to debug because when the system does not come up, your machine is dead and debugging facilities cannot be loaded without destroying the evidence left by the crash, ie. you need a chicken before the egg. The primary way to overcome this problem is to write clear, well-documented assembly code that can be painstakingly followed by 'hand' until the error is found. Built-in tracing output can also be helpful in locating the failure. Modular design and other structured programming techniques are a must. (Yes, structured programming is possible in assembler!)
- You should also have prior experience in software drivers for CRTs, printers, disk drives and boot ROMs. You will likely have to modify the boot ROM on your computer if you ever want to load the DOS with your reset button. If you modify a ROM, you will also need access to the appropriate EPROM programmer and associated software.
- This article assumes you understand the DOS well enough to write programs in assembler that access the operating system functions with software INT calls. We also assume you can implement an MS-DOS device driver and attach it to

the system at boot time with the appropriate DEVICE= command in a CONFIG.SYS file.

Given that you possess the above prerequisites, you should also have some good reasons for spending the effort to successfully port DOS to your computer. See if some of the following apply:

- Having control over your own operating system implementation provides independence from one manufacturer's software and the power to choose and tailor your system to your own needs. The ongoing flexibility of your own operating system compared to a commercially available system will have major advantages;
- You have a substantial investment in high-performance hardware and/or more than one or two computers for which IBM-PC DOS is both desirable and unavailable, and purchase of an IBM-PC or compatible instead of porting the DOS would be more costly or would not provide all desired capabilities;
- You already possess numerous I/O drivers that can be worked into a new BIOS for PC-DOS, significantly reducing development cost;
- Your hardware base is continually growing and you need an operating system that can grow with it. For example, our own systems have each grown to 10 I/O devices, 768k RAM, 72 megabytes of hard disk space, dual 8" floppies and dual 5.25" floppies. Everything is easily accessible under PC-DOS;
- You do not feel comfortable unless all the system software on your computer is under your total control. After all, manufacturers and distributors come and go, and the support for your computer can suddenly disappear leaving you stranded;
- You want to learn as much as possible about how PC-DOS works, and are not too concerned about the amount of time you will need to invest.

WHICH IBM-PC DOS IS BEST?

For the purpose of this discussion, we will assume that you will be porting the MS-DOS version known as IBM DOS 3.1 to your computer. Earlier versions could be used, but they lack many desirable features and your conversion effort will be roughly the same. Avoid completely versions prior to DOS 2.0 (ie. versions 1.1 and 1.25) or DOS 3.0 because of a variety of bugs and unimplemented features. DOS 3.1 supports greater disk capacity, shared files and network capabilities It has several new commands and has resolved various bugs present in earlier versions. Our version for the CompuPro (Viasyn) S-100 computer has been using DOS 3.1 since July 1985 without detecting a single operating system malfunction.

There is also a generic MS-DOS on the market, which is used by most of the IBM-PC look-a-likes. We have seen some bugs in these versions which do not seem to be present in the IBM versions at the same revision level. Although we have no direct evidence of this, we suspect the IBM versions are more fully tested and debugged than the generic versions. Because of this and because the IBM DOSes are much more available and reasonably priced, we suggest you avoid the generic MS-DOS versions altogether.

DOS & BIOS STRUCTURE

The DOS, as we will refer to it from now on, is contained in one visible and two hidden files on the IBM release diskette named COMMAND.COM, IBMBIO.COM, and IBMDOS.COM,respectively. The IBMDOS.COM file is the disk operating system itself, free of all hardware dependencies other than requiring an 8088 or 8086 CPU. The IBMBIO.COM file contains the machine code that provides an interface between the running IBMDOS-.COM and the underlying hardware. COMMAND.COM is the DOS command shell, which accepts user commands and controls program execution. To access the hidden files, you need to use a utility capable of finding and opening hidden files, such as DEBUG.COM or CHMOD.EXE (a public domain program), or you must write your own utility that uses extended FCB techniques.

The IBMDOS.COM and COMMAND.COM files will run totally unchanged on any 8086-family computer system. However, you will be replacing the entire IBMBIO.COM file with a new implementation which provides an interface to your particular hardware configuration. Virtually all the work in porting the DOS to your system is in the development and testing of your own custom BIOS (Basic Input/Output System). This BIOS will contain all the routines that are specific to your computer. To work properly, it must provide all the services and structures expected of it by the DOS. The BIOS can be divided into four major components:

- The first component is initialization of the BIOS from cold-boot. This involves moving the entire system to the base address of 0070:0000, determining the size of memory, calling the ROMBIOS initialization routine (if any), initializing any other hardware specifics (such as interrupt controllers), and jumping to the Startup Module to complete the cold-boot.
- Second is the chain of built-in devices. The built-in devices are provided simply as a linked list of device headers and associated code. These device drivers are designed in an identical manner to the custom device drivers attached at boot time by the CONFIG.SYS mechanism. Device drivers are described in some detail in the IBM DOS Technical Reference.
- The third component contains the ROM-BIOS emulation routines. The IBM-PC has a ROM in high address space to provide a low-level interface between the IBMBIO and the hardware. Since standard entry points into the ROMBIOS are called by many of the supplied utilities, we recommend you provide your own emulation of ROMBIOS functions to support these utilities. ROMBIOS emulation is described in more detail later on, is not hard to implement, and provides the compatibility necessary to run many IBM-only programs.
- The final component is the Startup Module. This relatively independent module within the BIOS is responsible for directly interacting with the DOS to finish all remaining initialization tasks. This code should be extracted from the end of your original IBMBIO.COM file and disassembled into a usable source file. We will give some details on how to go about doing this later in this article.

BIOS INITIALIZATION

The BIOS is entered from the bootstrap loader at its base origin of 0070:0000. However, most 8086 loaders on S-100 systems load a system at 0040:0000, just above the interrupt vector table (0000:0000), and then do a long jump to 0040:0000. Furthermore, if your development computer is running CP/M-86, it is desirable to boot your initial DOS port directly from CP/M as a command file (.CMD), which will of course load the system into some arbitrary base address. Therefore, your BIOS should, from the very start, always relocate itself to the required base address of 0070:0000 as the first initialization action.

Both the BIOS and DOS are internally relocatable code, so moving them to 0070:0000 is a simple task of copying the loaded memory image from its load address (ie. CS:0000) to 0070:0000 with one block move instruction. If there is any possibility that the copied image will overlap the loaded image, you must be sure to implement the move in the proper direction, so each byte is copied before it is overwritten with different contents. Because of this overlap problem, it is wise to PUSH a FAR RET address of 0070:START onto the stack, where START is the starting offset where your code continues from after the move. The block move instruction is then immediately followed by a FAR RET instruction, causing the CPU to jump to the correct location even if the move has overwritten the FAR RET before it is executed. This is possible because the 8086 CPU will already have the FAR RET instruction in its prefetch queue. However, you must of course ensure that the stack contents will be preserved throughout all of this.

If you have more than one boot device,

EDITOR'S NOTE

We have been in touch with several readers who have implemented PC-DOS on S-100 systems. As we went press with this issue we received a copy of another article on the subject. Because of space limitations we will not be able to publish it (it is really a small book). It includes a complete, well documented, BIOS. A copy can be obtained, on disk ($15) from the author: Fred Greeb, 8403 W. Iliff Lane, Lakewood CO 80227; (303)986-6651.

Readers should also be aware that Computer House (see ad in this issue) sells an implementation of PC-DOS for CompuPro systems.

for example a floppy and a hard disk, your boot-strap loader should communicate to the BIOS which device the DOS was loaded from. This information is needed later on to determine which drive to search for COMMAND.COM and CONFIG.SYS, and which default drive to 'come up' on. Therefore your BIOS should at this time store this boot source identification in a safe place where it can later be picked up by the Startup Module. However, do not complicate the first version of your DOS port with this feature. It can wait until you have reached the final 'bells-and-whistles' stage. Instead, assume that your system always boots from and defaults to the A: drive.

A memory search should now be made to determine how much memory is installed in your computer. You could make this a fixed quantity in your BIOS, but you would then have to modify your BIOS whenever your memory size changed. To determine your memory size, just cycle through memory, paragraph by paragraph, looking for memory that cannot be modified. A sample memory search routine is shown in Listing 1.

Next, your BIOS should fill the entire interrupt vector table with a vector to a special diagnostic routine that traps all unexpected INT calls and informs the user at the console whenever such an event occurs. This is very important to implement right from the start, because uninitialized interrupts are a likely cause of system crashes in early versions of your DOS port. You can get quite fancy about this feature by augmenting a plain UNEXPECTED INTERRUPT message with a full display of the registers, an indication of which interrupt number was trapped, ability to abort, reboot or return from interrupt, etc. All these 'extras' can be extremely helpful, but they are beyond the scope of this article to describe in detail.

The BIOS should now initialize the ROMBIOS module by calling an initialization entry point in that module, a topic described in the section entitled ROMBIOS Emulation. This call should be followed by any additional initialization that is required for your particular hardware configuration. For example, hardware interrupt controllers may need to be setup in a specific sequence for proper operation. All I/O initialization could be performed at this time as well, but the DOS will call the initialization entry point of each built-in device later after the Startup Module has been invoked, which you should take advantage of unless you have some overriding considerations.

Now display a BIOS sign-on message, for which console output was initialized in the preceding step. This is the only opportunity that you will have to display such a message, because the Startup Module is about to be entered. A signon message will be most useful during system debugging, since it proves that the BIOS was loaded and initialized.

The final action of the BIOS initialization before jumping to the Startup Module is to pass parameters to that module by way of PUBLIC variables:

- The total memory paragraphs currently installed in the system;
- The base segment address where the DOS image currently resides;
- The segment address where the BIOS ends, including all appended working variables and constants it will ever require. This is where the DOS image will be moved and where it will permanently reside;
- The drive number to be used as the default drive, and where the command shell and CONFIG.SYS files are to be found; and
- The address of the first device header in the linked list of built-in devices.

All remaining startup and initialization tasks are performed under control of the Startup Module, which is free of hardware dependencies.

BUILT-IN DEVICE DRIVER CHAIN

Although I/O drivers can be attached to this operating system at boot time, there are certain drivers that must be built into the BIOS for the system to start up. After all, how can the system process a CONFIG.SYS file without having any initial disk drivers? Character drivers also must be present to support the *standard* I/O devices: CON, PRN and AUX.

All the device drivers in the BIOS are designed just as if they were to be installed at boot time via a CONFIG.SYS file with DEVICE= commands. See the DOS 3.1 Technical Reference Manual for information about designing such drivers. Several important aspects of built-in device drivers include:

- All built-in drivers are linked together into a single list, using the link field of the driver header (as described in the DOS Technical manual). The last driver in the chain must point the address FFFF:FFFF to indicate that no more drivers follow.
- The minimal set of device drivers must include a console driver named CON, a printer driver named PRN, an auxiliary I/O device named AUX, a time/date driver named CLOCK$, and a block device driver for at least one disk drive. It is recommended that in your final system you also support devices named COM1, COM2, LPT1, LPT2, and LPT3, since these are the device names included in IBMBIO.COM, and may be referred to by name by programs developed for the IBM-PC.
- For the sake of simplicity in your first attempts, PRN and AUX devices can merely be place holders which perform their actual I/O operations with the console. However, the console (CON) must be implemented as fully as possible, and in particular, the non-destructive input command (command 5) must operate properly.
- The CLOCK$ device may also be implemented in a minimal way, by merely returning a 6 byte string of zeros on input requests and ignoring all output or other requests. However, if you do have a clock, the benefits of a full implementation are well worth the effort. Remember that you must set Bit 3 in the attribute field of the CLOCK$ device header to tell the DOS that this is the clock device. Also, note that dates are passed to and from the CLOCK$ device as the number of days since January 1, 1980. If your date hardware maintains the date in month-day-year format, you will have to convert all dates input and output to day counts to support it properly.
- The STRATEGY and INTERRUPT entry point protocols for all built-in drivers are so similar that you can economize your efforts by combining them into common entry points used by all device drivers.
- The initialization entry point (command 0) for each device is very important to implement. This operation is called exactly once for each device driver when the system first comes up, and is never called again. You should place all necessary initialization for each device into its respective INIT entry point. These individual INIT calls are performed in the order that the device drivers are linked together. If you have any order depencencies between your various drivers, be sure that they are linked in the appropriate way.
- The IOCTL entry points (commands 3 and 12) are never accessed by the standard DOS utilities, by the DOS itself, or by most other programs that run under the DOS. They exist primarily for custom applications and you should therefore leave them out of your implementation, at least initially.
- Be careful to set the attribute field of the device headers with the proper bit settings to reflect each device driver type. Just one wrong bit can easily prevent the

system from coming up.

- The console device CON has different attribute bit settings from the other character drivers: Bit 0 and Bit 1 will both be on to signify that CON is the "standard" input and output device. Optional for device CON is Bit 4, which tells the DOS that the console supports INT 29h for character output and ROMBIOS INT 10h for the CLS command. If you set Bit 4, you must implement both an INT 29h handler for console output and ROMBIOS emulation in your BIOS. Interrupt 29h is used by the DOS instead of normal CON driver STRATEGY and INTERRUPT calls to speed up console output, and can double its speed. The INT 29h handler simply takes the byte in AL and outputs it to the CON device, preserving all registers that are used.
- Do not implement a NUL device. This device is actually present in the DOS as the real head of the device chain and there is no need to replace it for any reason.

You are well advised to implement your built-in device chain as a separately assembled source module which is one of several object modules linked together to form the entire BIOS image. Your device drivers will likely be the most volatile area of your system and keeping them separate will help you manage the code as well as protect the other source modules in the system.

ROMBIOS EMULATION

Many useful program files are included on the PC-DOS release disk. Naturally, you will want as many of these as possible to work properly on your system. However, to run a PC-DOS program on a non-IBM computer, you must be certain that any hardware dependencies are removed or properly handled. Hardware dependence in a program can manifest itself in three major ways: use of IBM-PC ROMBIOS software interrupt calls, direct access to IBM-PC input/output ports, and direct access to fixed IBM-PC memory locations. All three are frequently present in programs developed for the IBM-PC because software developers have had to bypass the operating system in order to achieve adequate performance. More subtle but equally catastrophic dependencies can also appear because of programmed-in assumptions regarding device characteristics, control sequences, unit numbers, execution timing, or the way IBMBIO.COM is implemented.

Tables 1a, 1b and 1c show the PC-DOS program files grouped according to their hardware dependence. The first group of programs in Table 1a will require no changes or special attention to work properly. The second group (Table 1b) includes programs with at least one software interrupt call to the ROMBIOS routines which are built into the IBM-PC hardware but not included in PC-DOS, and so will not operate correctly unless you can deal with their ROMBIOS calls. The remaining DOS program files (Table 1c) are so hardware dependent that it is not practical to get any of them working without a major rewrite.

To use a program which makes ROMBIOS calls, it must either be patched to bypass each call (but preserving the desired effect), or your BIOS must provide an equivalent software interface to the program. Since you won't need any ROMs to emulate the ROMBIOS software interface, you can include ROMBIOS code directly in the BIOS. This is the preferrable solution because:

- None of the DOS system files will have to be patched, so you won't need to identify all the locations in each program which must be changed, and you won't have to figure out what each patch should be;
- Programs or systems which were written for an IBM-PC environment have a better chance of working properly on your system without alteration (or with fewer changes) if the ROMBIOS environment is provided in your BIOS; and
- Implementation of future DOS releases will be much easier, since you probably won't need to patch any of the new system files.

IBM has defined ROMBIOS interrupts numbered from 10h to 1Fh for the PC. These are listed in Table 2, classified according to their relative implementation difficulty. All programs access these routines only through software interrupts. Four of the routines are trivial to create: two simply return a word value in register AX, and two are IRET instructions. Five more will not be needed in normal operations: resident Basic, bootstrap, video initialization, diskette parameters, and video graphics characters. The remaining seven range from simple to difficult to develop, with interrupt 10h (video display) both the most difficult and most important to provide. For more complete documentation on ROMBIOS requirements see the IBM-PC, PC/XT or PC/AT Hardware Technical Reference.

Interrupt 10h for the video display is very screen capability dependent. Unfortunately, this is the one ROMBIOS routine which is most frequently used by programs, and complete emulation really requires hardware like the IBM-PC memory-mapped screen, which contains 25 lines of 80 characters and an attribute byte for each character. However, useful results can be obtained by emulating interrupt 10h calls to the extent possible on an ordinary CRT terminal. If you do this, programs which call the ROMBIOS to clear the screen, address the cursor, or perform other simple video functions will operate properly.

Like the other major components in the BIOS, the ROMBIOS should be implemented as a separately assembled module which is later linked together with the others into an executable image. The ROMBIOS module should have a PUBLIC entry point which is called to initialize the interrupt vector entries for the ROMBIOS routines, and which initializes the ROMBIOS data area at location 0040:0000.

STARTUP MODULE STRUCTURE

The Startup Module initializes the DOS, processes the CONFIG.SYS file, sets up the necessary device tables, and finally loads and starts the command shell. This module is rather complex and will vary in its details from one DOS version to another. But because it is free of hardware dependencies, it can be extracted from the IBMBIO.COM file and employed in your system. The steps you should follow to create a working Startup Module are as follows:

(1) Load IBMBIO.COM into a debugger with disassembly capability. It would be wise to perform this on an IBM-PC. Note where the end of this file is in memory.

(2) Locate the Startup Module within the memory image of IBMBIO.COM and save all the data from this location to the end of the memory image. Use the map given in Figure 1 to help you find its starting location.

(3) Dissassemble the resulting file into a usable assembly source file. This is not a trivial task and represents the most significant barrier to porting this operating system to your computer. If you can purchase a top notch disassembler for this task it will save you much work, not to speak of any sanity it preserves. The process of converting a disassembler's output into a usable source file will consist of the following steps:

(a) Many instructions will contain 'immediate values' that have been erroneously changed to labels. You must identify what these are and change them back into constants.

(b) Many instructions will have code labels on them which are not referenced anywhere in the source. These should be deleted so that 'real' labels can be identified and renamed with meaningful names.

(c) There are many calls in the Startup Module to INT 21h functions. Since they are documented in the IBM 3.1 Technical Reference Manual, you can use this knowlege to deduce the function of the surrounding context from which they are called. Table 3 lists all the INT 21h functions that are called from this module, plus some internal DOS

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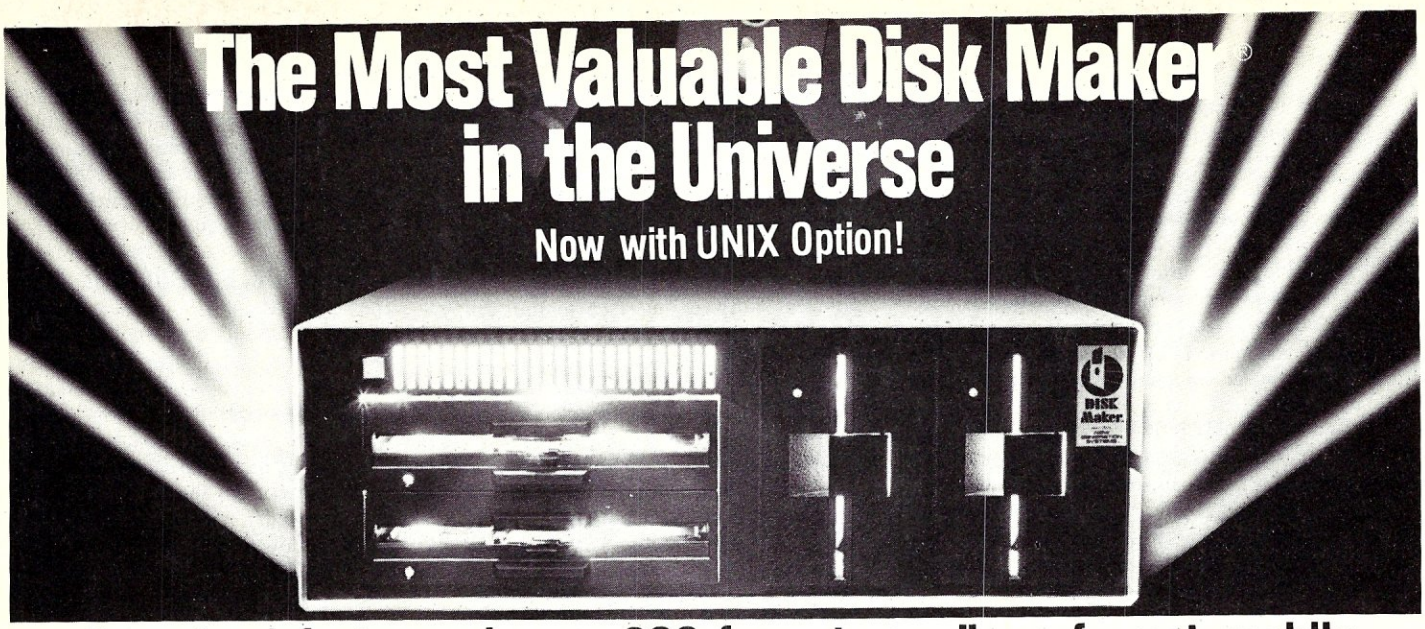

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calls whose function we have identified.

(d) Add the necessary assembler directives so that the new source file can be assembled without assembler errors. The Startup Module has all data and code in the same segment (8080 model), but frequently changes its segment registers.

(e) Before you make any substantive modifications to the code or data areas, make sure that your new source can be assembled, linked, and that the resulting image produced exactly matches the original image from which your disassembly was constructed. This is a good way to catch typos and other mistakes while they can still be caught.

When creating an acceptable source file from a disassembly file, you should strive for completely commented source with all disassembler-generated labels renamed to meaningful names. Like the other major components in the BIOS, the Startup Module should be implemented as a separately assembled module which is later linked together with the others into an executable image. Listing 2 shows the layout of the parameter data area in the Startup Module for DOS 3.1, which you must fill with appropriate values before jumping into the module.

In the next issue the authors will conclude with discussions of implementation strategy, loading the system into memory, preparing DOS-readable disks, getting the system to work, and extensions to the completed system.

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Kristofer Sweger has over fifteen years experience as an independent consultant and programmer. His assignments have included design and construction of custom systems and application software, development of computer data for litigation and research, and modeling and analysis of economic, production and transportation systems. He has extensive experience with a wide selection of programming languages on both large and small computer systems. His education includes graduate studies in Electrical Engineering and Computer Sciences at the University of California, Berkeley and a B.S. in Computer Science from California State Polytechnic College, San Luis Obispo. He is a member of ACM and the IEEE Computer Society.

Christopher Cochran has eleven years of experience that includes work in statistical analysis and mathematical programming, computer architecture, operations research, operating system design, programming language methodology and systems programming. He majored in computer science at the University of California in Berkeley and is the author of MegaBasic, a high performance, extensible 8086-based semicompilier designed for large scale programming use. Mr. Cochran has interests in astronomy, quantum mechanics, electronics, mathematics and is an accomlished jazz and classical musician on flute, saxophone and clarinet. He is a member of ACM.

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TurboCharge Your 8086/8088 Computer

by Stephen Davis

Part II
Run CP/M-80 on Your 8086/8088 Computer

In Part I (Nov/Dec '85 M/SJ) of this two part series, I discussed the advantages of the first two of NEC's V-series microprocessors over the conventional 8086 and 8088 microprocessors. I will now take a closer look at the ability of V-series processors to run 8080, as well as 8086 code.

HOW IT'S DONE

Intel's 8080 microprocessor, being a relatively early arrival, had a fairly simple internal structure which kept the transistor count down to a manageable level (the 8080 was actually a 3-chip set). Thus, except for special purpose registers, the instruction set of the 8080 is reasonably straightforward.

The next significant microprocessor improvement from Intel was the 8086/88 family. Being a direct descendant of the successful 8080, the architecture of this new processor family has an inescapable similarity to that of the 8080.

Thus, when NEC decided to add a second instruction set to their new V-series, the 8080's met all requirements: 1) a large user base, 2) relative simplicity, and 3) architectural similarity to the 8086. (Although the Motorola 68000 might have been an even more attractive alternative from the standpoint of user base, it was probably impossible to implement because it did not fulfill the latter two requirements.)

But how would you design a chip to execute two different instruction sets? As mentioned in Part I, most modern microprocessors rely on an internal program, known as the microcode, to interpret the actual machine instructions. If your microcode instruction area is large enough, you could include two separate microcode programs each designed to carry out separate, independent, machine-instruction sets on the same underlying hardware. This is apparently what the designers of the V20 and V30 microprocessors did. (Without actually adding an instruction set, designers at IBM pulled a similar trick when they rewrote the microcode of the 68000 processor in the PC XT370 to have it execute IBM 370 instructions.)

We will follow NEC's convention of calling the "8086/88-like" mode, native mode, and "8080-like" mode, the emulation mode. The name, *emulation*, is not meant to imply that the chip is running some emulation program. Emulation programs which run the 8080 instruction (and the Z80 superset) on MS-DOS machines have been around for some time, but all of them suffer from a lack of performance. In the V-series' emulation mode, a 5-MHz 8088 has roughly the throughput of a 6- to 7-MHz 8080. Apparently, there was not enough microcode space to implement the Z80 superset of instructions. When the V20 or V30 encounter these instructions, the results are unpredictable.

The chip keeps track of which mode it is in, by using two previously unused bits of the flag register. One of these flags, the emulation flag, is set to 1 whenever the chip is in native mode and cleared, when in emulation mode. This maximizes compatibility with the 8086, in which this flag would normally be a permanent.

Many of the internal registers of the V20 and V30 serve dual roles, being available both from native mode and emulation mode. This serves to reduce the overall number of hardware registers required by the chip, as well as facilitate communication between the two modes. The register correspondence between native and emulation mode is outlined in Table 1. Although the segment registers cannot be modified from emulation mode, the code, data, and stack segments are used just as they are in native mode; all opcode fetches are through the code segment, all data fetches through the data segment and all pushes and pops through the stack segment. Because of this, 8080 programs running under the V-series processor actually have a 192K, albeit segmented, address space.

EXECUTING 8080 CODE ON A V-SERIES CHIP

Several instructions have been added to the native and emulation mode instruction sets to facilitate switching from one mode to the other (see Table 2).

The instruction INTEM (INTerrupt into EMulation Mode) operates like an INT (INTerrupt) instruction, except that after pushing the status register onto the stack and before vectoring to the interrupt code, it clears the emulation bit, putting the chip in emulation mode. The emulation equivalent of the native mode IRET (Interrupt RETurn), RETEM (RETurn from EMulation) causes the status register, with the emulation bit set, to be popped back off the stack restoring the chip to native mode. This instruction also pops the return address back to the native-mode code as an IRET would.

While in emulation mode, however, calls can be made to native code through use of the CALLN (CALL Native mode) instruction. CALLN is the emulation-mode equivalent of INTEM, except that it sets, rather than clears the emulation flag. The called, native-mode program can return to

TABLE 1

Equivalent Emulation & Native Mode Registers

Emulation Mode (8080) Register	Native Mode (8086/88) Register
A	AL
B	CH
C	CL
D	DH
E	DL
H	BH
L	BL
(HL	BX)
SP	BP
PC	IP
FLAGS: C	C
Z	Z
S	S
P	P
AC	AC

Native mode registers not accessible from emulation mode: AH,SI,DI,SP,ES,DS,SS,CS

TABLE 2

V-series Emulation Instructions

INTEM nn	functions similarly to an 'INT nn' instruction, except it clears native-mode flag putting V-Series chip in emulation (8080) mode. Instruction allows 8086 code to call 8080 code.
RETEM	return from emulation to native mode after instruction BRKEM instruction.
CALLN nn	also similar to an 'INT nn' instruction, except CALLN called from emulation mode. CALLN sets native-mode flag. Allows 8080 code to call 8086 code.
IRET	normal 8086 instruction used to return to emulation mode from native code. Entered via CALLN instruction.

TABLE 3

Equivalent CP/M BDOS & MS/DOS or PC/DOS System Calls

Call	CP/M BDOS Function	Call	MS/DOS Function
1	reset; reload CP/M	0	return to MS/DOS
2	console input	1	console input
3	console output	2	console output
4	reader input	3	serial-port input
5	punch output	4	serial-port output
6	list output	5	printer output
7	direct-console I/O	6	direct-console I/O
8	get I/O byte	-	return 0
9	put I/O	-	ignore
A	print string	9	output string to stnd out
B	read console buffer	A	buffered console input
C	return version number	-	always return to vers 2.2
D	reset disk system	D	disk reset
E	select disk	E	select default disk
F	open a file	F	open a file
10	close a file	10	close a file
11	search for first	11	search for first
12	search for next	12	search for next
13	delete file	13	delete file
14	read sequential	14	read sequential
15	write sequential	15	write sequential
16	make a new file	16	create a file
17	rename a file	17	rename a file
18	determine logged-in drives	-	return all drives which are logged in
19	find default drive	19	find default drive
1A	set DMA address	1A	set disk-transfer address
1B	get allocation vector	-	return 0
1C	write-protect disk	-	ignore
1D	find R/O drives	-	return-no drive R/O
1E	set file attributes	-	ignore
1F	get disk-param block	-	return addr of dummy table
20	get/set user number	-	return user 0/ignore
21	read random	21	read random
22	write random	22	write random
23	get file size	23	get file size
24	set random record	24	set random record
25	reset drive	-	ignore
28	write random with zero fill	-	implement with write random

the emulation program by executing a normal IRET, which pops the status flag, restoring the emulation flag to its previous value.

When the V-series processor receives an external interrupt, it automatically reverts to native mode, as soon as it has pushed the status word onto the stack. Thus, interrupt routines must always be written in native code. When the interrupt handler returns from the interrupt (with the IRET instruction), the status word is popped off the stack, returning the chip to whatever mode it was in when the interrupt occurred.

RUNNING CP/M-80 ON THE V-SERIES CHIPS

The question does remain as to why you would want to run a different instruction set on the V-series processor. If you were a systems developer who had invested many hours in developing software on the 8080 for some particular application, you might welcome the opportunity to upgrade your product to run on a faster chip with a larger address space and an expanded instruction set. However, in all fairness, this group of programmers is probably not very large.

But if CP/M-80 programs could be made to run under MS-DOS, we might interest those CP/M-80 owners who have hesitated to buy an MS-DOS machine, since it would not be able to run their software. Likewise, MS-DOS owners who would like access to as yet untranslated CP/M-80 programs, might also be interested.

CP/M-80 is a particularly good candidate for emulation. Since MS-DOS was patterned after CP/M in the beginning, there is an almost one-to-one correspondence between the first 20 MS-DOS system calls and the CP/M BDOS calls (see Table 3). For a more detailed discussion of this topic see "Program Interfacing to MS-DOS, Part III"(M/SJ Sep/Oct '85). This similarity of system calls means that a CP/M emulator program would not have to reimplement the CP/M BDOS calls.

While it is true that virtually all CP/M machines today use Z80's as their processors, rather than 8080's, most CP/M programs limit themselves to the 8080 instruction subset so as to retain compatibility with the largest number of users. Thus the absence of the Z80's capabilities is not such a big disadvantage when running CP/M on the V-series processors.

What is needed, is a CP/M-80 emulator that runs CP/M programs in emulation mode and presents a CP/M BDOS/BIOS interface. One such package is the EMULATOR sold by GFI Electronics. To illustrate the principles involved, GFI has made available much of the source code for this product. Heavily commented excerpts from that source code appear in Listing 1 and are explained below.

Although the principles of C/PM emulators can be relatively simple, many tricks are necessary to make programs run which don't follow the rules of CP/M. Thus GFI's EMULATOR package is well worth the $49.95 purchase price (GFI Electronics, 1800 Avalon St., Olathe, KS 66062, 913-829-0157). My experience with EMULATOR shows it is capable of running most CP/M programs.

To use this package, the CP/M program must be converted to MS-DOS format. Then the user runs a utility which appends a prefix program onto the beginning of the CP/M-80 .COM file, generating a new .COM file only slightly larger than the original. When the resulting program is executed under MS-DOS, this prefix program is loaded along with the original CP/M pro-

gram. It then simulates the CP/M-80 environment to the 8080 code underneath.

Once loaded, execution of the program begins at the label 'Start:' in the listing. The first action is a check to make sure that the processor is capable of 8080 emulation. If not, an error message is generated and the program ends. We must now calculate the address of the 8080 code. The 8080 program was loaded along with the emulation prefix by the MS-DOS program loader. Since we know how big the prefix is, we need merely add the current code segment, held in the CS register, to the prefix size in paragraphs to find the segment address of the 8080 code.

Next, we generate the 8080 program's Program Segment Prefix (PSP). Here again our job is fairly simple. Since MS-DOS' PSP is almost identical to CP/M's, we copy our PSP into the first 100 bytes of the CP/M program's segment. Next we copy a jump table the BIOS calls and BDOS system call into the very high end of the CP/M program's segment (performed at label 'move_bios'). We now replace the BIOS and BDOS jumps of the PSP and point these at our jump tables (these are different between CP/M and MS-DOS) (which we do at 'place_jumps'). We initialize interrupt 60 to point to the beginning of the CP/M program, 61 to point to the BDOS call handler, and 62 through 69 to point to various BIOS call handlers.

Lastly, we pass control to the CP/M program with the INTEM EM_VECT instruction at 'start_cpm'. This performs an emulation interrupt to the CP/M code address which was just loaded into interrupt 60. Remember that we calculated the segment address of the CP/M program above by knowing both the prefix's code and size. Also we know that the offset of the CP/M program must be 100 hex. To insure maximum compatibility, we set the data-segment register to the CP/M segment.

Now examine the BIOS jump table appearing at label 'cpm'. These jumps appear just as they would in a CP/M environment, except that they each to code which does nothing more then call one of the prefix code's entry points. This is achieved by executing a CALLN through one of the emulation interrupts. Making the code execute these BIOS calls in the native execution area has two advantages: 1) it removes the code from the 8080 address space, thus freeing up a Transient Program Area (TPA) of greater than 63K and, 2) the calls can be coded with the more powerful instruction set of the V20 or V30.

The code necessary to perform the BIOS functions has been left out. Generally, every CP/M BIOS call can be executed by setting up the registers properly and making the corresponding ROM BIOS call. The routine which handles BDOS calls is educational (it starts at label 'bdos'). This routine looks up the BDOS call number contained in the CL register in the jump table 'bdos-fun'. All of those CP/M BDOS functions which have a corresponding MS-DOS function call with the same number (most of them do) vector to the routine 'bdosg'. This routine does nothing more than perform the MS-DOS call and pass the results back to the CP/M caller.

One of the BDOS calls which has no corresponding MS-DOS call has been included as an example. Since MS-DOS does not have a CP/M version number, the routine 'version' handles the 'return version number' system call by maintaining that it is version 2.2. Similarly, most other BDOS calls which have no MS-DOS equivalent can be responded to with some default response and otherwise ignored. The routine 'nogood', handles BDOS calls which are impossible or have no MS-DOS equivalent and can't be overlooked by putting a message on the screen or exiting to MS-DOS with an error level set.

Notice that since the V-series processor always processes hardware interrupts in native mode, all previously installed interrupt borrowers (such as Sidekick, screen blankers, keyboard enhancers, etc.) continue to work properly, even when invoked while running 8080 programs. Similarly, since all system calls are handled in native mode, CP/M programs should run under such environment managers as Windows, GEM, etc.

CONCLUSION

Through this two-part detailed examination, we see that the V-series processors can introduce significant improvements to an 8088- or 8086-based system. Although, they will not replace a turbo card, they do improve performance somewhat. They introduce several extensions to the 8086 family's instruction set, including the entire instruction set of the 8080. With the proper driver software, the V-series microprocessor will execute most CP/M programs at full speed (or better) on MS-DOS machines. All of these improvements are available to an MS-DOS system for around 1% of the system's original cost.

Stephen Randy Davis is a senior systems programmer at a defense contractor in Greenville TX, where he programs various microprocessors. He is working on his masters in physics after having graduated cum laude from Rice University in Houston.

PROGRAM LISTING

```
;
;This segment of a CP/M emulator, written by Jay Spronkle, is
;reproduced with permission of GFI Electronics.  The GFI
;package is designed to be installed onto beginning of a CP/M
;.COM file, resulting in slightly larger .COM file which
;executes on a MS-DOS machine equipped with a V20 or V30. This
;sample is large enough to demonstrate principles of a CP/M
;emulator for V-Series microprocessors, but for obvious
;reasons entire package could not be reproduced here.
;
        .186                    ;we want extensions...
        include 'extnd.inc'     ;...and unique instructions

;-----------------------------------------------------------
;
; Make sure there is a V20 installed...
;
;
        org     100H            ;this program MUST be built into
                                ;.COM file!  If it were .EXE file
                                ;structure would be all wrong for
                                ;loading by MS-DOS
;
start:
        j_not_nec stop_now
        jmp     v20
;
; 8088 is installed, print error and terminate.
;
stop_now:
        doscall 9,m8088         ;tell them I can't run on 8088
        doscall 4CH,2           ;exit with error
m8088:   db 'Cannot run program, V20 not installed!',13,10,'$'
;
;-----------------------------------------------------------
;
; Calculate segment address of CP/M 80-code -- this is
; done by adding offset of CP/M code from beginning
; of emulation program to code segment of program.
; (See article for further explanation)
;
v20:
        mov     ax,beg_of_cpm   ;get CP/M-80 offset code
        shr     ax,#4           ;convert to segment offset
        mov     bx,cs           ;now add to our segment
        add     ax,bx           ;& calculate CP/M-80 segment
        mov     beg_of_cpm,ax   ;store this back
        mov     es,ax           ;& set up es from here on out
;
;-----------------------------------------------------------
```

```
;
;Create CP/M PSP --
;PSP in MS-DOS is almost identical to CP/M PSP, so make copy
;of our PSP into CP/M PSP area (main differences, contents of
;address 0 & address 5, will have to be set up specifically)
        mov     di,0
        mov     si,0
        mov     cx,100H
        rep     movs byte
;
;-----------------------------------------------------------
;
;Construct BIOS/BDOS jump table at very top end of 8080
;address space.  By placing these jump tables this high, we
;get TPA of 63+K!
;
        mov   si,offset header:bseg ;get jump table address
        mov   di,biosadr            ;get stuff to move address
move_bios:
        mov   al,cs:[si]        ;get a byte
        inc   si                ;increment source pointer
        mov   es:[di],al        ;write it to CP/M space
        inc   di                ;increment destination pointer
        jnz   move_bios         ;go until all copied
;
;-----------------------------------------------------------
;
;place jumps at location 0 and 5
;
;These 2 jumps are used by CP/M-80 program to access CP/M-80
;operating-system support routines.
;
place_jumps:
        mov     al,0C3H         ;this is an 8080 jump
        mov     es:[0],al       ;set 0
        mov     es:[5],al       ;set 5
        mov     ax,biosadr      ;jump to BDOS emulator address
        mov     es:[6],ax       ;set address of jump
        add     ax,9            ;skip to jump for warm start
        mov     es:[1],ax       ;set address of jump
;
;-----------------------------------------------------------
;
;Set up BIOS vectors and BDOS vector --
;interrupt 60 points to the CP/M 80 code
;         61                BDOS handler
;         62-69             BIOS handlers
;
EM_VECT  equ     60H                    ;Emulation int

emulate:
      mov     ds,beg_of_cpm ;get segment address of CP/M
      mov     dx,100H       ;CP/M starting address always 100H
      doscall 25H,,em_vect  ;set vector to enter CP/M program
                            ;(MS-DOS call 25 sets address
                            ;of specified interrupt; in this
                            ;case, set address of interrupt
                            ;60H to beg_of_cpm:100H)

      mov     ax,cs                 ;get code segment
      mov     ds,ax                 ;set ds back to us
      doscall 25H,bdos,em_vect+1    ;BDOS entry-point vector
      doscall 25H,nono,em_vect+2    ;invalid BIOS-call vector
      doscall 25H,const,em_vect+3   ;console-status BIOS vector
      doscall 25H,conin,em_vect+4   ;console-input BIOS vector
      doscall 25H,conout,em_vect+5  ;console-output BIOS vector
      doscall 25H,listout,em_vect+6;list output-BIOS vector
      doscall 25H,auxout,em_vect+7  ;aux-output BIOS vector
      doscall 25H,auxin,em_vect+8   ;aux-input BIOS vector
      doscall 25H,listst,em_vect+9 ;list status-BIOS vector
;
;-----------------------------------------------------------
;
;Now start CP/M-80 program-
;note we will start his stack pointer (our BP) at 80, his
;code & data segment to be CP/M segment we calculated all
;along
        mov     bp,80H          ;CP/M stack in BP
        mov     ax,es           ;get CP/M program segment
        mov     ds,ax           ;set ds for data ops in 8080 mode
        intem   EM_VECT         ;goto 8080 mode
        doscall 4CH,0           ;we will return here on cold or
                                ;warm start, so return to MS-DOS


;===========================================================
;
; The CP/M BDOS emulator
;
;-----------------------------------------------------------
;
; BDOS emulator
;
bdos:
      cmp   cl,24H      ;see if valid BDOS call
      ja    bdosit      ;if valid call, jump through table
      iret              ;not valid, exit

bdosit:
      mov   al,cl             ;set function number
      mov   ah,0              ;make 16-bit word
      add   ax,ax             ;double value for word pointer
      mov   si,ax             ;set pointer to table entry
      jmp   word ptr cs:bdosfun[si] ;jump through table entry
;
;-----------------------------------------------------------
;
;far & away most BDOS calls come here, where equivalent
;MS-DOS 1.1 call is performed

bdosg:
      mov   ah,cl         ;move function number to ah for DOS
      int   21H           ;pass through to DOS
      iret
;
;some BDOS calls require special handling; here is a sample:
;
;-----------------------------------------------------------
;
;Tell anyone that asks we are version 2.2 of CP/M
;
version:
        mov     bx,0022H        ;tell them we are CP/M 2.2
        iret                    ;return to caller
;
;we just con't handle some BDOS & BIOS calls; better trap out
;with an error than to crash
;
;-----------------------------------------------------------
;
;bad BDOS call
;
nogood:
      doscall 9,msgb                    ;print message
      doscall 4CH,2                     ;error running
;
;-----------------------------------------------------------
;
;Jump table to BDOS function handlers
;
bdosfun dw      0         ;system reset, return to MS-DOS
        dw      bdosg     ;console input
        dw      bdosg     ;console output
        dw      bdosg     ;aux-input
        dw      bdosg     ;aux-output
        dw      bdosg     ;list output
        dw      bdosg     ;direct console I/O
        dw      auxist    ;***aux input status
        dw      auxost    ;***aux output status
        dw      bdosg     ;print string
        dw      bdosg     ;read console buffer
        dw      bdosg     ;get console status
        dw      version   ;***return version number
        dw      rstdsk    ;reset disk system
        dw      select    ;select disk
        dw      bdosg     ;open file
        dw      bdosg     ;close file
        dw      bdosg     ;search first
        dw      bdosg     ;search next
        dw      bdosg     ;delete file
        dw      bdosg     ;read sequential
        dw      write     ;write sequential
        dw      bdosg     ;make file
        dw      bdosg     ;rename file
        dw      login     ;***return login vector
        dw      bdosg     ;return current disk
        dw      bdosg     ;set dma address
        dw      dalloc    ;***get addr(alloc)
        dw      wrtprt    ;***write protect disk
        dw      getvec    ;***get r/o vector
        dw      nogood    ;***set file attributes
        dw      nogood    ;***get addr of dpb
        dw      exit      ;***get/set user code
        dw      bdosg     ;read random
        dw      bdosg     ;write random
        dw      bdosg     ;compute file size
        dw      bdosg     ;set random record
;
;msg     db      'Attempted unsupported BDOS call'
crlf    db      13,10,'$'
;
;-----------------------------------------------------------
;
; CP/M program resides here
;
bseg    segment byte public 'biosseg'
zero    equ     $
        jmp80   bdose-bioslen
ibmacs  equ     $
        db      0,0,0
                                ;copy into highest CP/M
                                ;address space
        jmp80   msdos-bioslen   ;cold boot
        jmp80   msdos-bioslen   ;warm boot
        jmp80   bioscs-bioslen  ;console status
        jmp80   biosci-bioslen  ;console input
```

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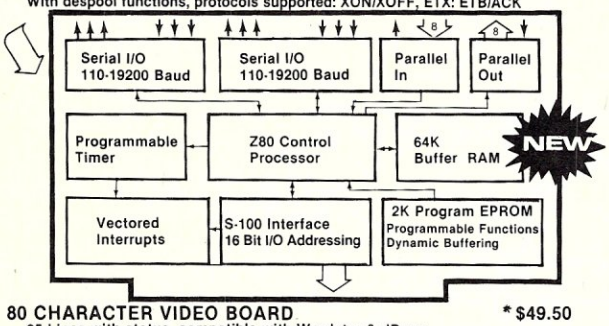

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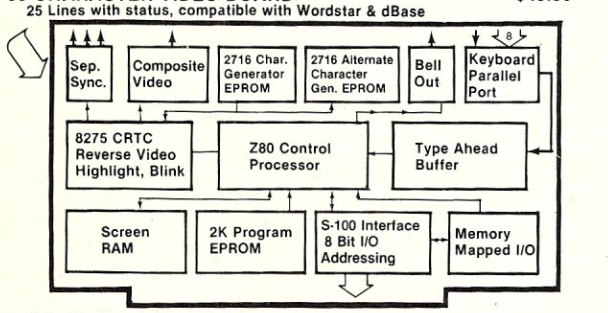

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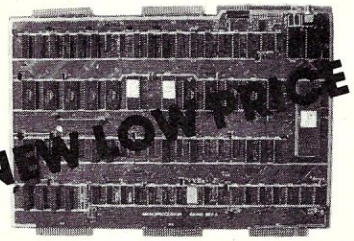

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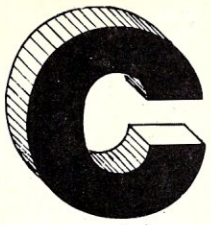
```
        jmp80   biosco-bioslen  ;console output
        jmp80   bioslo-bioslen  ;list output
        jmp80   biosao-bioslen  ;aux output
        jmp80   biosai-bioslen  ;aux input
        jmp80   biosu-bioslen   ;home disk
        jmp80   biosu-bioslen   ;select disk
        jmp80   biosu-bioslen   ;set track
        jmp80   biosu-bioslen   ;set sector
        jmp80   biosu-bioslen   ;set disk-transfer address
        jmp80   biosu-bioslen   ;read disk
        jmp80   biosu-bioslen   ;write disk
        jmp80   biosls-bioslen  ;list status
        jmp80   biosu-bioslen   ;sector translation
bdose    equ    $
        calln   61H             ;BDOS emulator
        ret80
biosu    equ    $
        calln   62H             ;unsupported BIOS call
msdos    equ    $
        retem                   ;return to MS-DOS
bioscs   equ    $
        calln   63H             ;console status
        ret80
biosci   equ    $
        calln   64H             ;console input
        ret80
biosco   equ    $
        calln   65H             ;console output
        ret80
bioslo   equ    $
        calln   66H             ;list output
        ret80
biosao   equ    $
        calln   67H             ;aux output
        ret80
biosai   equ    $
        calln   68H             ;aux input
        ret80
biosls   equ    $
        calln   69H             ;list status
        ret80
bioslen  equ    $               ;length of stuff in segment
biosadr  equ    zero-bioslen
bseg     ends
```



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Functions

abs	conbuf	feof	getcseg	isascii	movmem	replace	strcat
asm	conc	ferror	getdseg	iscntrl	open	repmem	strcnip
asmx	cos	fflush	getd	isdigit	outp	rewind	strcpy
atan	cpystr	fgets	putd	islower	peek	right$	strlen
atof	creat	fileno	getdate	isprint	perror	rindex	strncat
atoi	cursblk	filetrap	gettime	ispunct	poke	rmdir	strncmp
atol	curslin	find	geti	isspace	poscurs	scanf	strncpy
bdos	curscol	floor	puti	isupper	pow	setbuf	strsave
bdosx	cursrow	fopen	getkey	itoa	printf	setbufsiz	system
bios	cursoff	fprintf	getmode	keypress	putc	setcolor	tolower
biosx	curson	fputs	setmode	left$	putchar	setdate	toupper
calloc	delete	fread	gets	len	puts	settime	ungetc
ceil	drand	free	getw	log	putw	setjmp	ungetch
cfree	exec	freopen	heapsiz	log10	rand	setmem	unlink
chain	execl	fscanf	heaptrap	longjmp	read	sin	write
character	execv	fseek	hypot	lseek	readattr	sound	writechs
chdir	exit	ftell	index	malloc	reach	sprintf	xmembeg
chmod	exitmsg	fwrite	inp	alloc	writech	sqrt	xmemend
clearerr	exp	getc	insert	mathtrap	readdot	srand	xmemget
close	fabs	getch	iofilter	mid$	writedot	sscanf	xmemput
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cmpstr	fdopen	getchar	isalpha	modf	rename	str$	_exit

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Program Interfacing To MS-DOS

by William G. Wong

Part V - Programming MS-DOS

This installment discusses the remaining functions not covered previously. These include useful and unique operations such as acquiring the MS-DOS version number and two small groups of functions related to memory allocation and program execution.

DISK ACCESS CONTROL

Read access to disk files includes error detection to verify the validity of the data being read from the disk. This is normally done using the CRC (error detection information) associated with each sector on a disk.

Unfortunately, normal write access to a disk file only places the CRC information on the disk. An error may occur while writing to the disk but this would not be detected until the sector was read. However, this is usually too late to correct the error. Reading the information after writing verifies that the sector was properly written is the only way to assure that the correct data is written to the disk.

This mode of operation can be built into an application but usually complicates development of the application and always slows it down. MS-DOS provides an alternative, implement the read after write verification in the operating system. Two functions are provided to manipulate this operating mode. The first returns the current setting which defaults to off. The following code will get the current write verify mode.

```
MOV AH,54H   ;AH := get verify mode
INT 21H      ;DL := current verify mode
```

The other function allows the verify mode to be set or reset. The following two code excerpts perform these operations.

```
MOV DL,0     ;DL := always 0
MOV AL,1     ;AL := turn on verify mode
MOV AH,2EH   ;AH := set/reset verify mode
INT 21H      ;turn on verify mode

MOV DL,0     ;DL := always 0
MOV AL,0     ;AL := turn off verify mode
MOV AH,2EH   ;AH := set/reset verify mode
INT 21H      ;turn off verify mode
```

Now, why not turn verify mode on *all* the time? Well, it takes at least twice as long to operate in verify mode than it does in non-verify mode because each write requires an accompanying read operation. To top it off, the delay time between a write and the verifying read operation is one disk revolution so the average sector access time changes from half a disk revolution to one and a half disk revolutions. This could bring many applications to a grinding halt or at least slow them down appreciably.

Therefore, there is a tradeoff to be made. The verify mode provides a good deal of valid data assurance at a cost in time. This tradeoff must be balanced with operating time for the application. The slowdown factor will be a function of the number of write operations performed.

In general, disks tend to be *very* reliable and the verify mode is normally used in only very harsh environments where more errors tend to occur or in environments which have very valuable data that must be accurate.

The advantage of placing the verify operation in the operating system is that the mode can be set independent of the application programs. Thus, you can run your accounting software with the verify mode on and a word processor with the verify mode off.

GENERAL STATUS

Now for a number of miscellaneous functions. Knowing the version of the current operating system is valuable since different options are available on each implementation. The following shows how to get the current MS-DOS version number.

```
MOV AN,30H   ;AH := get version number
INT 21H      ;AL.AH := version number
```

Version 2.1 of MS-DOS returns AL set to 2 and AH set to 1.

The control-break option is available on some systems. It is normally a special key, or combination of keys, on the keyboard and allows the user to terminate a program at any time. This option can be disabled by an application or the control-break interrupt vector can be changed by the application as discussed in an earlier article.

The current status of the control-break option is obtained using the following code:

```
MOV AL,0     ;AL := get mode
MOV AH,33H   ;AH := control-break option
INT 21H      ;DL := current option
```

Setting the mode on or off is done using the following code:

```
MOV DL,1     ;DL := set option (0 = reset)
MOV AL,1     ;AL := set mode
MOV AH,33H   ;AH := control-break option
INT 21H      ;set control-break mode
```

The next function is used to get the country dependent information. This information would be used by applications which display or read information based upon time, currency or large numbers. The function returns this information in a parameter block located in the application referenced by the DS:DX registers. The contents of the data block are described in the following table:

Offset	Bytes	
0	2	date/time format (0=USA hh:mm:ss mm/dd/yy) (1=Europe hh:mm:ss dd/mm/yy) (2=Japan hh:mm:ss dd/mm/yy)
2	1	Currency symbol
3	1	Always 0
4	1	Thousands separator
5	1	Always 0
6	1	Decimal separator
7	1	Always 0
8	27	Reserved

Note, the zero fields allow the various character parameters to be referred to as zero terminated strings. The following code will load a parameter block in the current data segment.

```
MOV DX,OFFSET PARAM ;DS:DX := PARAM addr
MOV AL,0            ;AL := get data
MOV AH,38H          ;AH := country info
INT 21H             ;get country depend-
                    ; ent info
```

DEVICE CONTROL

Disk and device files can be accessed using the functions described in the previous articles. This access is to the data within a file. MS-DOS provides an additional function to access control information associated with a file or a device. The I/O control function allows an application to determine the type and status of a file. The MS-DOS function code (44 hex) is placed in the AH register while the AL register contains an additional opcode described in the following table. The file handle is passed in the BX register. The handle must have been opened or created using the MS-DOS functions 3C hex (create) and 3D hex (open).

Opcode	Description
0*	DX := device info (see below)
1	Set device info (DX = new value)
2	Read CX bytes into DS:DX from control channel
3	Write CX bytes from DS:DX to control channel
4	Read CX bytes into DS:DX from drive (BL) (0 = default, 1 = A:, etc.)
5	Write CX bytes from DS:DX to drive (BL)
6*	AL := input status (0 = not ready, 0FF = ready)
7*	AL := output status

*Opcodes 0, 6 & 7 valid for disk files
Opcode 6 function returns 0 if end of file
Opcode 7 function always returns 0FF hex

Device Information

Bit	Description
0	1 if device is console input
1	1 if device is console output
2	1 if device is NULL device
3	1 if device is clock device
4	Reserved (must be zero)
5	1 if binary mode 0 if end of file character is 1A hex
6*	End of file indicator (0 = end of file)
7*	1 if device, 0 if disk file
8-13	Reserved (must be zero)
14	1 if device can process control strings
15	Reserved (must be zero)

*Only bits 6 & 7 are used if disk file & bits 0-5 are block device containing file

This MS-DOS function operates differently based upon the type of file which can be obtained using opcode 0. Disk files support only a limited number of opcodes. The primary use of this function with disk files is to determine when the end of the file is reached or to check which drive contains the file.

This function allows the type of a device to be determined. Applications can therefore determine how data is to be read or written to a file. For example, console ouptut may be formatted for 80 character lines while printer output may be formatted for 132 character lines.

The control string operations are device driver dependent and are usually not supported for disk devices. One use could be with communication device drivers where parameters such as baud rate to be modified or examined. This would be much cleaner than going directly to serial I/O ports.

MEMORY ALLOCATION

Programs running with a simple operating system normally use all available memory. More complex programs on such systems may access different modules via overlays or by chaining. MS-DOS allows these types of operations and also allows multiple programs to be resident at one time although only one may be active at a time. In this case each program cannot utilize all available memory, otherwise there would not be enough room for additional programs.

Therefore, MS-DOS provides some basic memory management functions. MS-DOS allocates memory from a common pool in variable sized contiguous blocks whose size is an integral number of 8086 paragraphs where a paragraph is sixteen bytes. Blocks always start and end on a paragraph boundary.

An application can be allocated any number of blocks as long as there is sufficient free memory available. MS-DOS keeps track of the available memory space and where it is located. Programs always reside in an allocated block of memory. In fact, the base page of a program is located at the start of the block containing the program.

A program will initially be located in a block which covers the largest free block available at the time the program is loaded. A program should first reduce the size of this block to the minimum size required to run the program before asking MS-DOS to allocate additional space since MS-DOS will typically use any space returned to it by the program. The following code would perform this operation:

```
                ;AX  = segment to change
MOV ES,AX       ;ES := segment
MOV BX,SIZE     ;BX := new size
MOV AH,4AH      ;AH := modify block size
INT 21H         ;AX := result
```

where the result indications are listed in the following table:

Result	Description
0	operation successful
7	memory block destroyed
8	insufficient memory
9	invalid memory block

The size of the memory block for a program is normally reduced but it could be increased later. The possibility of increasing its size is based upon the memory allocation scheme and the amount of free memory above the program since data blocks cannot be moved in an 8086 DOS environment. However, applications running on a 80286 or 80386 may be movable depending upon the type of support provided in future versions of MS-DOS.

Even so, the normal mode of operation is to reduce the size of the program segment and then allocate smaller blocks for various data structures. The amount of memory which can be allocated may exceed that freed by a program if there are noncontinguous free memory blocks available.

This dynamic memory allocation and deallocation support is very useful for programs which use a large amount of memory for various functions but not at the same time. For example, sorting large arrays in memory uses large amounts of memory. If print spooling is to be performed after the arrays are no longer used then the memory used for the arrays could be used for print spooling. Letting MS-DOS keep track of the various memory blocks is much easier than doing it within the program and allows future extensions to MS-DOS on 80286 and 80386 machines to support expanded and virtual memory in a much cleaner fashion.

The function to allocate memory requires the number of paragraphs to be provided. This value is passed in the BX register and the segment is returned in the AX register. A value of 7 or 8 indicates an error and does not conflict with free memory allocation since this area is reserved for interrupt vectors and MS-DOS. An error 8 indicates insufficient memory and BX contains the size of largest free block available. The following example shows how a small segment is accessed.

```
MOV BX,10       ;BX := size in paragraphs
MOV AH,48H      ;AH := allocate memory
INT 21H         ;AX := segment number
CMP AX,8        ;check for error
BLE ERROR       ;skip if no memory
```

Freeing an allocated memory block is as simple as:

```
                ;AX  = block to free
MOV ES,AX       ;ES := block to free
MOV AH,49H      ;AH := free block
INT 21H         ;free block
```

Errors 7 and 9 may be returned if the block has not been allocated by MS-DOS or the memory allocation system is corrupted. All allocated blocks, with the exception of the program block should be freed before a program terminates.

PROGRAM LOADING/EXECUTION

Loading overlays and other programs has always been difficult on simple operating systems. MS-DOS V1.x provided limited support but made the initiating program do most of the work. MS-DOS V2.x and later provides more sophisticated support along with the memory allocation functions mentioned earlier.

The first function is used to create a new program segment. This has been superceeded by the load/execute program function described later in this section. However, it is sometimes useful for debugging-style programs which need to build up a program environment. The create program segment function requires the segment number of a previously allocated block. The segment number can be within an existing block for MS-DOS V2.x and V3.x but it is not recommended. The segment number is passed in the DX register as shown in the following example:

```
MOV DX,PROGSEG ;DX := pgm segment
MOV AH,26H     ;AH := create pgm segment
INT 21H        ;create new pgm segment
```

The information in the current program segment is copied to the new program segment. The memory block size and error interrupt vectors are also placed into the program segment. The program code must be loaded by the application and the new program must be initiated by the program.

This function is actually superceded by the Load/Execute function (MS-DOS function 4B hex). The function supports two modes specified by an opcode in the AL register. One allows programs to be loaded and executed and the other provides overlay support. Each uses a parameter block referenced by the ES:BX register pair and they both require the name of the file which contains the code to be loaded in an ASCII zero

terminated string reference by the DS:DX registers. This is the same type of file name used with the UNIX-style file open and create functions. The following tables summarize the parameter block information.

Load and Execute (opcode = 0)

Offset	Size	Description
0	2	Environment string segment
2	4	Command line address
6	4	Addr of default FCB at 5Ch
A	4	Addr of default FCB at 6Ch

1. Initiating program must restore all registers including SS and SP.
2. All open files are inherited by new process.
3. Environment string segment contains a set of ASCII strings terminated by a 0 (null string). The strings are of form: parameter=value.

Load Overlay (opcode = 1)

Offset	Size	Description
0	2	Segment to load overlay
2	2	Relocation factor to be used

The overlay mechanism can also be used to load programs into segments initialized by the MS-DOS Create program segment function described at the start of this section. This call uses the loader portion of COMMAND.COM which is loaded at the top of memory. This function will return a nonzero error code if the loader is not available or the file cannot be accessed.

MS-DOS will allocate a memory block for the load/execute opcode but requires a previously allocated block for the overlay opcode. The memory block will automatically be released by the load/execute initiated program when it terminates unless it uses the MS-DOS function 31, terminate and stay resident.

The terminate and return result code function was mentioned before but its use becomes apparent with the load/execute function. The result code is passed in the AL register by the terminating program using MS-DOS function 4C hex. This result code can be obtained by the program which executed the load/execute MS-DOS function by executing the following code:

```
MOV AH,4DH      ;AH := get result code
INT 21H         ;AL := code, AH := mode
```

where the result code in AL is the one specified by the terminating program. The result modes are listed in the following table:

Mode	Description
0	normal termination
1	control-break exit
2	critical device error
3	terminate and stay resident (MS-DOS function 31)

SUMMARY

This wraps up the operations available for MS-DOS V2.x. The system is very flexible and provides an upgrade path from CP/M style programs to UNIX-style programs. The memory allocation and program support are useful but allude to more powerful system implementations.

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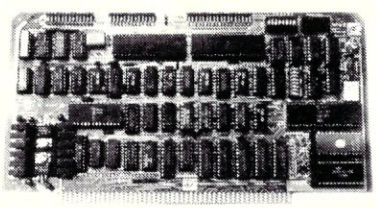

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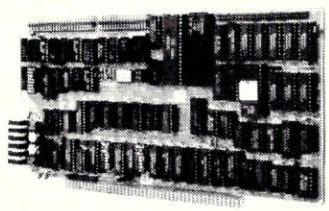

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TurboDOS/PC

Making the PC Multi-User PC-to-S-100 Connection

by Michael Guttman & Vince Mills

The makers and users of multi-user micros have long argued that their systems offer a more reliable and cost-effective solution to most business applications than the ubiquitous IBM-PC. However, even the most sophisticated user now finds it hard to pass up the many useful and innovative software products spawned by the PC.

Fortunately, S-100 users don't necessarily have to swim against the PC tide. New products and approaches are coming to market that effectively marry S-100 systems to the PC. One of the more intriguing products in this genre is TurboDOS/PC, a software product from Software 2000 that allows a PC to act as a node on a TurboDOS network.

TurboDOS/PC is definitely not a consumer product. It is aimed strictly at system integrators, who must make the appropriate adjustments to run it properly with their hardware. A typical configuration would call for a multi-user micro running TurboDOS to act simultaneously as a network file server for one or more PCs.

One such implementation of TurboDOS/PC comes from Intercontinental Micro Systems, Anaheim CA, a well-known maker of S-100 products. Among their current offerings are ARCNet interface boards that can be used to hook PCs to an S-100 micro running TurboDOS, or to another PC. ICM generously provided us with both the S-100 and PC interfaces, appropriate software, a compatible TurboDOS computer and, for a day, a technician to get them up and running.

The possible uses for such a configuration are virtually endless. The end user gets all the advantages of both the TurboDOS and PC environments and can preserve his investments in both. On the one hand, he can add inexpensive terminals to his high-performance S-100 machine to act as workstations for generic production functions such as word processing, accounting, and the like. At the same time, he can hook up PCs of varying configurations to run popular PC-based software while sharing files and peripherals with S-100 users and other PCs.

WHY ARCNet?

The choice of ARCNet rather than the better known Ethernet is logical given the likely audience of TurboDOS/PC. ARCnet uses a token-passing system, which tends to be one-third the cost of a comparable Carrier-Sensing Multiple Access/Collision Detection (CSMA/CD) system, such as Ethernet (tm).

At the same time, ARCNet's 2.5 Mbit/s data transfer speed can easily outperform Ethernet's 10Mbit/s in a lightly loaded network. ARCnet tends to degrade proportionately with network loading, whereas Ethernet has been reported to bog down at even 40% utilization. This performance difference is due to ARCnet's token-passing arrangement; no time is wasted on data collisions. Another key to the economy of ARCnet is hidden in cabling costs. Whereas Ethernet requires special cabling and expensive taps, ARCnet offers a choice of twisted-pair or coaxial connection. In our tests, every cabling scheme tried worked the first time (even with unshielded telephone wire!).

Although it is relatively inexpensive, ARCNet has plenty of power. Advanced users of TurboDOS/PC can make use of the more sophisticated features of ARCNet to create very elaborate networking structures that provide for a rich mix of multi-user systems and PCs. ARCnet protocol allows linking up to 4000 users per network with 255 nodes per network segment over either coaxial or twisted pair cable. Cable lengths can be up to 40 miles between processors with active repeaters, or hubs. With a passive hub, cables can be stretched 2300 feet without difficulty.

HOW THE NETWORK OPERATES

Using ARCnet, TurboDOS/PC interfaces to MS-DOS or PC-DOS as an installed device driver and interrupt-driven background task that handles ARCnet reception and transmitting. To the user, the network consists of one or more remote disk drives and printer ports. These are mapped into the file server (either an S-100, PC, XT, AT or clone system) with full record-locking and printer buffering.

The master processor is the critical component of the network. It must mediate the network, as well as handle disk and printer requests from the slave nodes. Doing this right requires both exceptional computing performance and fast drives. It also requires a high-performance, multi-user operating system. TurboDOS, a variant of Digital Research's multiuser MP/M, appears to be a good choice. It has been optimized for split-second DMA, large-capacity drives and file sharing, and offers compatibility with the large pool of CP/M-based software.

TurboDOS will run on S-100 systems with Z80A/B or 8086 origins. ICM sells single-board microcomputers based on Z80A/B and 80186 that are configured for network master use. In the system we tested, an 8 Mhz 80186 chip ran the operating system, with 256K onboard memory. The rest of the card cage contained the ARCnet interface board, an extra 256K memory board and the hard and floppy disk interface.

Optionally, the system can can also be configured with one or more Z80 or 8086 slave processors, which are then mapped into the same memory as the network master processor. These can run business and accounting applications compatible with C/PM-80 or M/PM-86 record and file locking, using standard ASCII terminals.

THE SOFTWARE

TurboDOS runs virtually all programs designed for CP/M and MP/M and features full record and file locking for applications that may need it. All the familiar CP/M commands are there, such as COPY, FORMAT, DIR, etc., although some commands use slightly different conventions for assigning parameters. User security can be enforced through LOGON and LOGOFF.

TurboDOS/PC is a PC's gateway to the TurboDOS network. As a network client, the PC is offered access to the file and print

servers in the network. Note that while one file server may be the norm for most installations, any number of servers can be online in the network.

TurboDOS/PC can accommodate all MS-DOS versions. Each time the PC is started, a memory-resident program is installed from the AUTOEXEC.BAT file. This program in turn loads the network driver file. The driver needs to be customized with an included configuration utility. This sets various network parameters such as network addresses, number of local disks, number of remote disks and printers, etc.

After this driver has been configured, an additional memory-resident program can be run to establish the printer server link. TurboDOS/PC accommodates both local and remote printers. Each of the 16 remote printers are assigned a letter (A, B, C, etc.) Printer output from your PC can be directly printed on a character-by-character basis or queued for spooled output. Printing modes are controlled with a PRINT command.

For example, to send printed output to the printer attached to his PC, a user merely types 'PRINT LOCAL'. Similar commands specify which remote printer to print to, and whether a queue is to be used. Full print job control is provided with the PRINTER command, which can take a printer offline, restart or abort a queued print job.

Through the TurboDOS software, all file requests are handled transparently through extra disk drives. Limited subdirectory capabilities are allowed, although all subdirectories on the file server encroach on the 31 user numbers allowed under TurboDOS. TurboDOS/PC maintains a mapping between each MS-DOS subdirectory pathname and the corresponding TurboDOS user number. In addition, the remote file servers return standard DOS error message equivalents to the PC, indicating disk errors such as door open, read error, etc.

If removable disks are switched in a remote file server, TurboDOS/PC provides a CHANGE command to write open files to disk and hold it inactive during the switch. This is not unreasonable overhead; changing disks in a file-sharing environment may require group consent. Another command, REASSIGN, lets you temporarily reassign the logical drive letters. This is useful when an inflexible application requires a certain environment.

TurboDOS/PC also provides a RESET command that clears any open files in the server. According to ICM, some internal MS-DOS commands, like COPY, tend to leave files open, which may make it difficult to change disks or shut down a server.

Finally, a command called MASTER puts any PC in control of the filer server console. This is useful when necessary to BACKUP, FORMAT, BOOT or otherwise manipulate drives in the server. Of course, it is also possible to issue such commands from a terminal connected directly to the serial port on the master processor.

PERFORMANCE

We experienced no operational problems with either the hardware or software once it was properly installed; it ran flawlessly for over a month, including days of continuous testing. The server box, which was based around a Rodine 202E hard disk, had no problem transporting data over our two-user network at sufficient speeds to rival local hard disk access.

One somewhat irksome problem we found concerns the relatively slow speed with which files resident on the server are found when using a wild card (* or ?) in the file specification. This is because Turbodos uses a hashing algorithm for its directory which is very efficient for locating absolute file names but requires a sequential search on disk for ambiguous ones.

Unfortunately, this problem also extends to loading MS-DOS programs, because the MS-DOS loader in effect asks for an ambiguous file name so that it can execute either .COM, .EXE, or .BAT files. This can make for annoying waits during program loading, especially when directories are large. Another related problem is the absence of time and date stamping for files, which was omitted apparently to save operating system time.

These problems seemed pretty minor compared to generally excellent overall performance and reliability of the network. Cost-wise, the system compares favorably with other networks. From ICM, the TurboDOS/PC software lists for $100, and each network card about $495. (ICM is a hardware manufacturer and software distributor, so prices to distributors and dealers are lower.)

WHITHER TURBODOS-PC?

Software 2000 and ICM have done an admirable job in providing a viable connection between PCs and CP/M based multi-user micros. For users or vendors with a substantial existing commitment to CP/M software and S-100 hardware, this may be the vehicle that allows them to keep pace with the PC revolution.

The product could also conceivably appeal to existing PC users who want to move into multi-user applications and see S-100 systems as a viable alternative. Certainly, current market surveys suggest that many more PC users are beginning to think about multi-user applications.

However, these same surveys also seem to indicate that most users are more likely to wait around for network hardware and software standards to emerge in the MS-DOS environment than to migrate to the older but less familiar S-100, CP/M-based multi-user micros. Fortunately, those who have reasons to buck this trend have a good option with TurboDOS/PC.

Byte Magazine called it,

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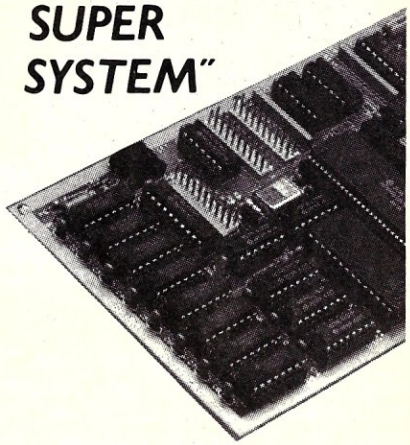

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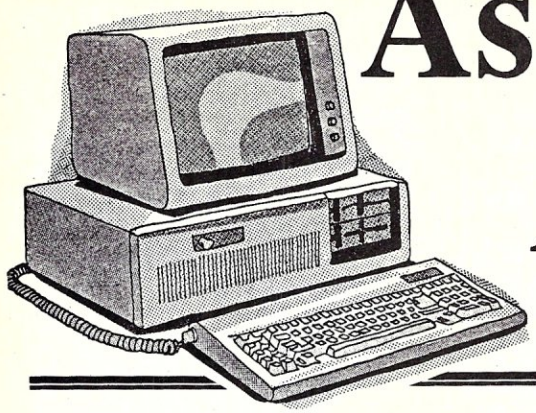

Assembling An AT Clone

By Sol Libes

In the March/April and May/June '85 issues of M/SJ Henry Kee and I discussed our experiences assembling PC and XT clones. The PC/XT-clone marketplace has changed a great deal in the past year, with prices dropping to well under the $1,000 level for fully equipped systems.

Clone makers have also begun shipping AT clones. The AT marketplace has already reached a saturation level and prices on AT clones are dropping rapidly. In this article I will discuss my experiences putting together an AT clone.

WHY AN AT?

If someone had told me a year ago that I would soon have, at home, a full 16-bit system with 1Mbyte of RAM (plus video RAM and a cache memory here and there) and 33Mbytes of hard disk storage, I would have replied that "they were out of their cotton-pick'n minds." But here I sit writing this article on just such a system. The cost was about $3,000....which incidentally is about the same as what I paid for my old S-100 system about 4 years ago. That system has a 6-Mhz Z80, 128Kbytes of RAM, two 1Mbyte 8" floppy drives, 4 ports and a Zenith terminal.

We needed another system here at the M/SJ publishing empire (located in our basement). We have two part-time people working for us now and there are evenings when all of us are pounding the keys. One system may be doing data-base updating, another preparing an article for typesetting, and another editing. We have our old S-100 system, which is today used only for interfacing to authors who send us 8" CP/M disks. Our other two systems are a very old PC and the XT-clone described in the May/June '85 article (which is still clicking away). The PC was purchased when IBM first introduced the machine in late '81. It still has the old 64K RAM motherboard with the old BIOS ROM and cassette interface. The machine was expanded over the years and now has a 10Mbyte hard disk, 640K of RAM, two floppies, clock/calendar, two serial and one parallel ports and a color graphics display. It has come a long way from its humble beginnings.

I bought the PC at a flea market from a fellow who had bought it only a few weeks earlier and needed the cash for a down payment on a plane. At half the list price I couldn't pass up the deal. It came with single-sided drives and 64K of memory and PC-DOS version 1.0. Version 1 was an almost exact copy of CP/M. At the time, my S-100 system ran rings around the PC. When, in late '82 IBM introduced version 2 of PC-DOS, I expanded the machine to 256K, changed to double-sided drives and bought some of the really good software coming out for the PC. By 1983 I began to use the PC more than the S-100 system.

At the school where I teach my department purchased an AT in the spring of '85 and I began using it. I immediately became spoiled by its lightening fast speed. Disk accesses appeared to be almost as fast as RAM disk and gone were the long waits for sorts and compiles. I began longing for an AT of my own, but the high cost put me off. When the AT clones appeared, at more realistic prices, I decided to jump in.

WHAT DOES IT COST?

There is no doubt that the cost of an AT clone is significantly more than an XT clone.....but, it is about the same price as a comparably equipped IBM-XT.

When I bought my XT clone dealers were only selling parts and it was up to me to assemble the system. Things changed rapidly and today most dealers sell an assembled system for the same price, or less, than the cost of the separate components. The same is pretty much true for the AT-clones.

I bought my AT-clone from PC's Limited, 7801 N. Lamar, Suite E-200, Austin TX 78752 (800-426-5150). I bought a basic system for $1,995.00. The system included an AT-clone motherboard with 1Mbyte of RAM, 1.2Mbyte floppy drive, two serial ports and a parallel port, clock/calendar, and a disk controller (with cables) to handle up to two floppy drives and a hard disk drive. In addition I decided to splurge and ordered a 30Mbyte drive for another $849. A 20Mbyte drive would have saved me only $150. I had shopped around and could have bought a drive and components for probably a hundred dollars less but I had heard good things about this mail order outfit.

I added a standard graphics display controller card ($119) and monitor ($85). Since I already had PC-DOS for my other systems I did not have to buy it again. Thus the total cost was slightly over $3,000....about $1,000 more than a comparably equipped XT-clone!

WHAT DID I GET?

About 2 weeks after I placed my order over the phone a big white box arrived containing the system. I was pleased to find the hard disk already installed in the unit. Documentation consisted of three sheets of paper telling me (in very very few words) how to set the switches on the motherboard and keyboard and how to install PC-DOS on the hard disk.....more about this later.

The motherboard was made by Faraday, the disk controller card by Western Digital, the hard disk by Seagate and the floppy drive by Teac, all well known and respected manufacturers. The power supply is rated at 193 Watts and contained no manufacturers identification. The cabinet is a very close copy of IBM's AT cabinet.

The motherboard contained 1Mbyte of RAM in 4 banks of 256K chips (all socketed). This was a pleasure to see after looking at the IBM kluge of soldering 4 banks of 64K memory chips atop of 4 banks to get 512K on their motherboard. Another nice thing was that the 2 serial ports and one parallel port were on the motherboard leaving 6 free slots for plug-ins. At school, I had to install two plug-in cards to get that I/O capability, leaving only 4 available slots. Another pleasing thing here was that the ports all used standard 25-pin connectors. IBM's interface cards now come with 9-pin connectors for the serial port and at school I had to make up adapters to go from 9 to 25-pins. Making up the cables was not easy since the documentation included with the AT did not include any pin-out information.

However, there was one small annoyance in that the port connectors did not

include screw posts to secure the mating connectors in place.

The one sheet of instructions on setting up the motherboard left quite a bit to be desired. For example there are some switches and connectors on the motherboard which are not identified. There are also some empty sockets on the motherboard which are not identified. I suspect that, if one wanted, one could buy a technical manual from Faraday

The same is also true for the floppy/hard disk drive controller card. There is no information provided and there are quite a few jumpers and unused connectors on the card.

Because of this lack of documentation I recommend this system only for the person with experience bringing up a microcomputer system. This system is certaining not a plug-it-in-and-flip-on-the-switch system!

INSTALLATION

I removed the cabinet cover, installed a standard graphics controller card (also a clone), set a jumper on the motherboard for the type of display controller used, connected the monitor, and slid a floppy system disk into the drive. I turned on power and the system booted up.

I was able to access the hard disk as drive c. The dealer had taken the trouble to initialize the hard disk drive for me. Using the standard IBM FORMAT program I installed the operating system on the hard disk and the system was all set.

It should be pointed out that if you buy a hard disk separately you may have to initialize the disk yourself. To do this you will need a copy of the IBM AT Diagnostics disk, which is not furnished with PC-DOS 3.0. Only the "Standard" Diagnostic disk is furnished. All IBM dealers have a copy of this disk in their service departments.

If, when powering up the system, with no floppy disk in drive A, you get an error message code of "1790" you know that the hard disk has not been initialized and you will have to do this with the SETUP program found on the AT Diagnostics disk. After running SETUP, run the FDISK program on the Standard Diagnostics disk to set the partitioning of the hard disk drive and last format the disk and move the operating system on to the hard disk.

One other important point to know if you buy your drives separately. AT cabinets require that the drives have rails attached to their sides. The drives then can be slid into their compartments and secured from the front of the cabinet. Therefore, make sure that any drive you purchase has these rails.

PERFORMANCE

The Seagate drive was rated for 40 msec and proved as fast as the IBM's drive. I ran several tests to check boot time, copying files from the hard disk to floppy and vice versa and some sorting and compiling tasks. The clone appears to have essentially the same speed as the IBM. It should be pointed out that performance was almost four times faster than a standard PC/XT. (In a subsequent article we will discuss souping up the performance of a PC/XT system.)

Like the old IBM-AT the processor's clock crystal plugs in and looks like it can be changed easily to provide even faster performance. Several companies sell replacement crystals for this purpose. It should be pointed out that the current production of the IBM-AT now has its crystal soldered in place and a new ROM to prevent altering the clock speed.

The keyboard's key layout is an exact copy of the IBM-AT. However, there are a pair of switches on the underside of the keyboard which allow its use with a PC/XT and also repositioning of the ESC key to left side of the keyboard (its more common location). The keyboard has a very different feel from the IBM keyboard. The key travel is less and there is no audible key-click. I suspect users with a lighter touch will prefer it. Others, like me, who have a heavy touch and were raised on IBM keyboards will probably not like it.

I did experience one problem with the system. I did quite a bit of physical probing around inside the system. After reassembling the system I discovered I could no longer boot from the hard disk. I could still access the drive but found that the File Allocation Table had been severly damaged. The CHKDSK program, which can usually restore a damaged FAT, was unable to handle the problem and I had to reformat the entire hard disk drive and reinstall the operating system. Fortunately, I had backed up all my files....but it did take about an hour to reinstall my trashed files.

IN CONCLUSION

I have no qualms recommending this system to experienced users who need the added speed. It is certainly not for the uninitiated. The company provides a 30 day, no questions asked return policy, with a 90% refund and they do claim to provide telephone technical assistance.....I did not find it necessary to call them.

It is possible to purchase components separately and put together your own system. For example, one advertiser in this magazine (Atlaz) sells many AT-compatible components (case -$119, Keyboard - $109, power supply $169 and motherboard - $950). If you have a cheap source for drives and controller this approach will cut the cost of putting together an AT clone.

Within the next few months we should begin to see more AT components from the Far East reach our shores. Prices should really tumble and the price difference between XT and AT clones should lessen. Further, we can expect to see "turbo" AT-clone systems running at twice the speed of the IBM-AT.

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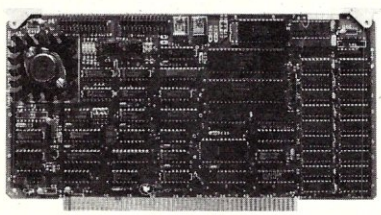

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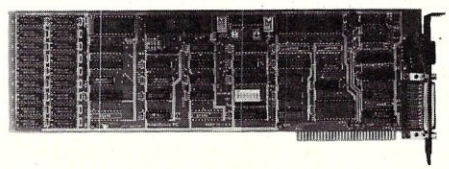

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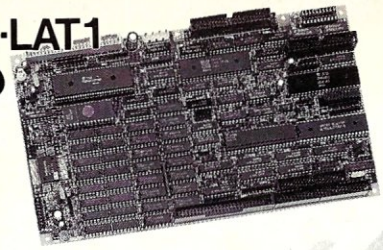

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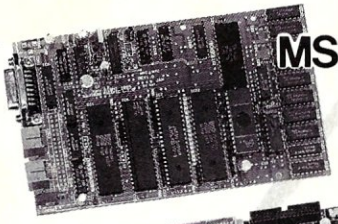

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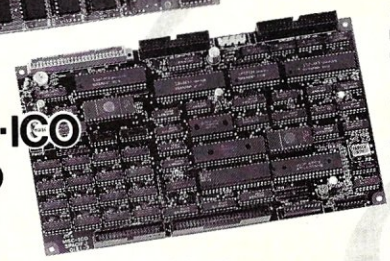

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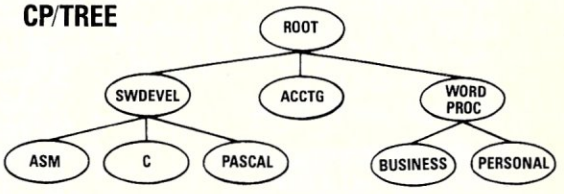

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Linker features:

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Z-8000 Cross Development Package

Instant Z-8000 Software! This package allows development and conversion of software for the Z8001, 8002, 8003 and 8004 based machines on a Z-80, Z-8000 or 8086 machine. This powerful package includes:

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- Z-8000 Macro Cross Assembler and Linker

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Cross reference table generated—

Plain English Error Messages—

System requirements for all programs: Z-80 CP/M 2.2 System with 54k TPA and at least a 96 column printer is recommended. Or 8086/88 256k CP/M-86 or MSDOS (PCDOS).

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8748	199.50	500.00	199.50	199.50	199.50
8044/51	199.50	500.00	199.50	199.50	199.50
8080	199.50	500.00	199.50	199.50	199.50
8085	199.50	500.00	199.50	199.50	199.50
8096	199.50	500.00	199.50	199.50	199.50
68020	399.50	750.00	399.50	399.50	399.50
68000,08,10	299.50	750.00	299.50	299.50	299.50
6800,02,08	199.50	500.00	199.50	199.50	199.50
6801,03	199.50	500.00	199.50	199.50	199.50
6804	199.50	500.00	199.50	199.50	199.50
6805	199.50	500.00	199.50	199.50	199.50
6809	199.50	500.00	199.50	199.50	199.50
32000	399.50	750.00	399.50	399.50	399.50
COPS400	199.50	500.00	199.50	199.50	199.50
NSC800	199.50	500.00	199.50	199.50	199.50
6301	199.50	500.00	199.50	199.50	199.50
6501/11	199.50	500.00	199.50	199.50	199.50
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Software Review

Scientific & Technical Word Processors

Part II - Four More Packages

By Steven Bosak

In the concluding part of this series, we review four more technical and scientific word processors. I must note that I was unable to *put the screws to* some of these products; some manufacturers believed it best not to have new, unproven products reviewed, while others did not get their programs to me in time for Micro/Systems' deadline. Still others submitted only demo disks for "evaluation". The latter case -- a company sending demo disks -- is absolutely insulting when testing programs that are so dependent on intensive use and reliable performance. Demos can do what the average user may not, while glossing over or completely eliminating printer and other performance bugs and glitches. When you test drive a car, do you let the dealer sit behind the wheel and describe how the steering feels?

Another problem, which also pertains to the last systems on my review list, has to do with the Superlok (TM) copy protection program. Two of the packages used this program to defeat copying. Both caused no end of headaches in the installation process. A particularly nasty implementation of Superlok ate three FORMAT.COM utilities, two DISKCOPY.COM utilities and trashed the technical writing program's own printer drivers and screen installation. Real friendly, huh? Gee, I sure am glad that Superlok, and the companies using its marvelous protection, have their paranoid anti-copy interests so high on their priority list that the "protection" actually DESTROYS the program when it is being legitimately installed. That must be the ultimate protection of all! No installation, no illegal copies! But enough soap-boxing, let's look at the processors themselves.

Once again I used the MS-DOS Zenith Z-150 with 640K RAM and dual floppies to test the programs. I test-printed with the Toshiba P351 high-speed, letter quality dot matrix printer whenever possible. My back-up printer was the 'ol reliable Epson MX-80; some programs did not support the P351 or the NEC 35 series which I had at my disposal.

TECHWRITER

TechWriter has a number of features to recommend it, including the ability to produce ASCII files and to automatically save to disk. These are features I'd like to see in most *regular* word processors. Other *extras* in the realm of straight word processing include recovery from disk full, print queuing and spooling from within the program, and automatic creation of table of contents and indices.

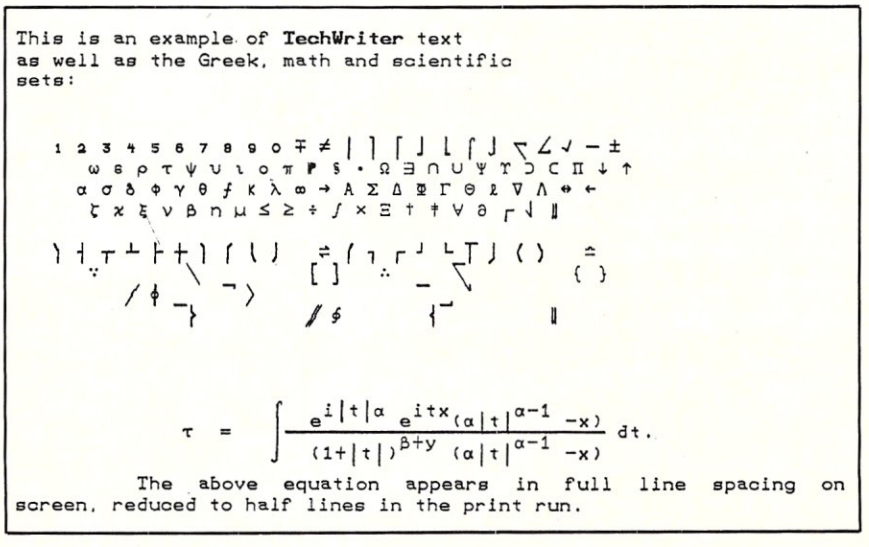
INSTALLATION: It's a shame that the installation of TechWriter is not as thoughtful as many of its features. Granted, the copy protection is what fouled my experience the most, but the batch operation which guides this installation is riddled with annoying "Are you sure?" interrogations after the most mundane selection of options. For instance, the "Are you sure?" prompt must be answered after choosing between a Hercules Graphics card OR the IBM graphics adapter. These additional rib-pokers made an already long installation that much longer. I won't even detail the exploits of the cannibalistic Superlok.

FEATURES: The opening menu sends you to new documents, editing old documents, over to the print sub-menu or to file management or DOS. The print menu allows you to set all the usual page and line defaults as well as the printer driver you wish to use. A number of drivers can be on disk for the program to load in.

TechWriter, as I said, handles all the usual word processor *musts*: word wrap, formatting, search and replace, and deletion by character, word line, sentence or block. Headings and footnotes as well as horizontal scrolling are a big plus here.

The character set supplied with TechWriter is better than most, but those needing chemical symbols or graphics displayed within their manuscripts will not find any support here. Still, if you deal with the usual Greek and math characters, you'll find a number of TechWriter's methods for entering alternate characters a welcome relief from many of the programs that require flipping back and forth between modes.

The first mode of Techwriter's alternate character entry which I was impressed with was its use of an "after key" definition. In other words, when entering an "alpha" character, I typed a regular "a" from the keyboard, then defined that "a" as an "alpha" by pressing the F6(Greek and math) key directly afterwards. I really appreciate this approach for two reasons: There were very few keystrokes and no switching in and out of modes, and I found that this "after key" method was an effective mnemonic for familiarization with the


This is an example of TechWriter text
as well as the Greek, math and scientific
sets:
The above equation appears in full line spacing on
screen, reduced to half lines in the print run.

alternate character set. I saw on the screen which regular character would get me a Greek or math character. By seeing the regular character before it transformed into its Greek or math counterpart, I found myself memorizing the keyboard alternatives fairly quickly and referring to the keyboard overlay (which was printed far too small) or the on-screen pop-ups very infrequently.

Techwriter's built in macro facility, GNOME, makes large brackets and braces, large sigma and other characters easy to construct, save, and recall. And the GNOME was available for all "regular" word processing tasks also.

Entry of equations was painless and straightforward. Two sizes of sub and superscripts were available, although the smallest is difficult to read on the screen. What you see on the screen is almost what you get. Equations are full line spacings on screen, reduced to half lines during a print.

In my print sample you'll note curious gaps -- the printer and TechWriter's printer driver couldn't quite agree on matters, although the blanks were characters on the screen.

DOCUMENTATION: The documentation was great. The program comes with a training manual and a reference manual in separate vinyl, full-sized binders. The training guide was thorough and well organized. The reference manual was easy to use, to look up features and commands, or to read through beginning to end for a more complete understanding of the system. I only wish there had been more information on the printer drivers, as it seemed from some cursory definitions that some drivers did not totally support the package. The documentation was thoughtful and clear all around.

PRINTING: After you provide TechWriter with the defaults, printing is a breeze. You have the option of revising your defaults at any time, as well as changing print drivers before a print session. You need to know the filename of the print driver, however, and there is no way of getting that name without exiting the print section and doing a directory check. If you work with a number of drivers, it may be frustrating trying to remember the correct spelling for a driver. Better to rename your drivers to simple and easily recalled names or, better yet, mark them down somewhere.

I must add, as a person using a number of printers, that switching from printer to printer as well as queuing and spooling from within the program are all great features, a must in any office.

TechWriter was slow at printing, however. The quality and speed of the laser printer might be better, but all the packages I've reviewed have this same drawback. The printouts were only marginally faster on the P351 than on the MX80, although the quality, even in the low resolution mode, was much better on the Toshiba P351. I have no idea how this package might fair on the Diablo or on some of the other printers it supports.

FINAL CONSIDERATIONS: The print speed, the limited character set with some printers and the present installation procedure are TechWriter's major drawbacks. Nevertheless I found it to be a fast editor and reliable word processor. If some of TechWriter's deluxe features -- auto indexing and GNOME for example -- appeal to your office needs, and you can get by with the fixed Greek and math character sets, this would be a good office or home technical processor.

TechWriter also runs on a greater variety of systems than any other word processor I've seen. If your office has a few of these machines, and you anticipate porting your manuscripts back and forth between them, TechWriter might be ideal.

I also found some of TechWriter's key assignments a bit quirky, the standard *delete* key on my keyboard was, for some perverse reason, TechWriter's *help* key. (That takes SOME getting used to). My *insert* key was TechWriter's *escape* key. And the *escape* key? Why,that was TechWriter's *tab* key...

SUMMARY: Highly valuable in any office for many of its outstanding regular word processing features, TechWriter needs a better installation procedure and a bit more speed. Check the character set to be sure it has all you need. With an update or two this could be an outstanding package.

QUICK REFERENCE
PRODUCT:
TechWriter
CMI Software
1395 Main St.
Waltham, MA 02154
(617)899-7244
SYSTEM REQUIREMENTS:
MS-DOS 2.xx or 3.0 on a PC,XT,AT or compatible with two disk drives, 256K RAM, a color graphics card or equivalent or Hercules monochrome graphics card or equivalent. Additional systems supported are the Apple IIe or II+ with 48K RAM and a PCPI APPLI-CARD. The DEC Rainbow with 128K RAM and CP/M-86/80 2.0 and a DEC color graphics card. Northstar Advantage with 64K RAM and CP/M-80 operating systems and two disk drives.
PRINTERS SUPPORTED:
HP Laser Jet
Diablo 630 ECS
Nec Spinwriters--all models
NEC 8023
C. ITOH Prowriter
DEC LA50
Toshiba 1340 and 1351
Apple ImageWriter
IBM Graphics or compatible
Epson MX, FX or compatible
PRICE:
$595 includes scientific word processor, sample documents disk and printer drivers disk. Educational institution and student discount price is $495.

SPELLBINDER SCIENTIFIC

Spellbinder by Lexisoft is a popular word processor in its own right. With spelling and grammar checking, a four-function calculator and installed macros that allow list processing, two column printing, mailmerge and form handling, it's no wonder. If you already use Spellbinder, just go out and get Spellbinder Scientific -- everything you liked about Spellbinder is here, so you'll feel right at home. In addition, you have the features of the technical and scientific text processor, all in one neat package.

INSTALLATION: Installation was complicated by the copy protection: seems my original Prolok(TM) disk was damaged in transit--I could only run the program with the original and the authorized backup in the system at the same time--ah, the joys and convenience of copy protection! After the trials of Prolok, installation was relatively easy--you can even configure the features of the grammar module!

FEATURES: As I mentioned, Spellbinder is a good word processor, and its Scientific brother is no exception. The character set available was more than adequate for physics and math applications. As a bonus, an extensive chemical building-block set is included; from these chemical sets any possible chemical symbol or structure can be created. The same macro abilities that allow merge and forms handling in the regular text, enable you to chain your chemical building blocks for simple retrieval.

Without a doubt, Spellbinder Scientific has the most flexible and useful font generator in any program I have reviewed to date. Like such generators in similar scientific word processors (T3 and Proofwriter),

Spellbinder allows you to address the character grid pixel by pixel to modify existing fonts or to create wholly new characters which can be saved in Spellbinder's set. An important and impressive aspect of Spellbinder Scientific's generator is its ability to preview on screen what the newly modified or created character would look like on screen BEFORE it was saved out to disk. And the touch of one function key sent the "experimental" character to the printer to check results on that end. (figure 1) The generator alone makes this product superior. If font generation is your main concern, you want total control over the fonts displayed and printed, or if you need to create a number of special characters, stop searching -- this is the word processor for you. In addition to its generator, Spellbinder Scientific has extensive equation editing capabilities -- sections of an equation can be moved, duplicated, even stored on disk to be retrieved, all with simple cut and paste maneuvers.

The technical text is entered within modes, however. To get a math character you must hit the mode selector to get "math" and then the key which corresponds to the desired symbol. It takes a while to get the hang of finding the right mode. And why these modes were not more logically arranged is beyond me. For instance, when in normal text mode (F9 when editing) you must hit F10 to get to "math". You'd think hitting F9 would get you back to normal type -- wrong, TWO strokes of the F9 get you back to normal type. These problems would be intolerably confusing if the programmers at Lexisoft hadn't thought to tell you, boldly and clearly, in the upper right corner, just what mode you are in: italics, math, chemical, normal, or raised.

The overprint and raised modes are available for all the character sets -- normal, italics, and math -- making diacriticals and tildes exceptionally easy to enter, create, and subsequently save.

The character sets can be reviewed through menu-driven pop-up keyboards or on the handy, hard plastic reference cards provided with the documentation.

DOCUMENTATION: Spellbinder Scientific came with a "Quick Start" manual to get users entering and editing with the Scientific package within minutes. Not bad for starters. The documentation for Spellbinder's standard word processor is also included, as well as a supplement explaining the scientific and technical processor. The documentation itself was, overall, well written. I only wish Lexisoft had spent more time making it visually appealing. The type was small and difficult to read, the inner margins so thin at times that the three ring binder threatened to devour the text. The layout was logical throughout. The technical and scientific character section concerning character editing and creation was especially well done. The equation editing and chemical graphics segments were illustrated with useful examples. I just wish it was easier to flip through to needed sections or less wearisome on the eyes -- VDT strain is enough for one set of eyes to contend with!

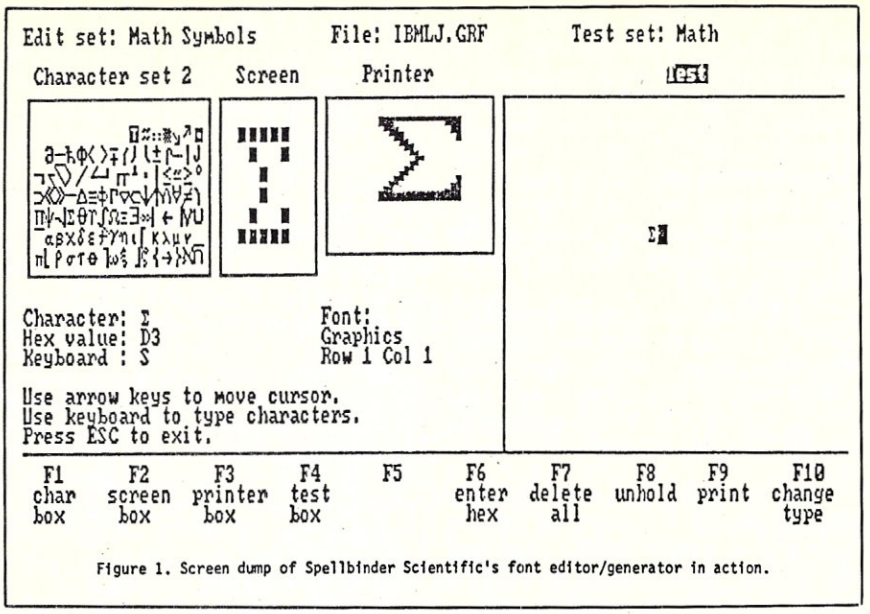
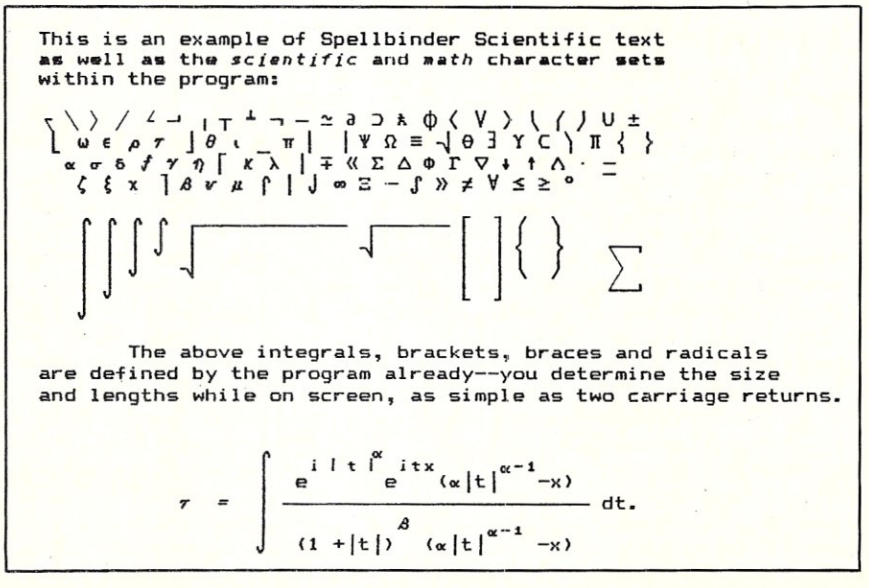


Figure 1. Screen dump of Spellbinder Scientific's font editor/generator in action.

PRINTING: Printing was easy and fairly fast. You could not however, change drivers without re-installing an alternate driver. In addition, I find Spellbinder's format commands even more bothersome than WordStar's. Character after character must be added up on the command line to get the page formatted the way you want. To be fair, this allows extreme flexibility for the final print, and once you have the knack of the codes, they pretty much become natural, many never need to be changed (default margins and page length, for instance). One aspect of the print routine seemed unnecessarily harsh, though. On one print run, I had neglected to turn the printer on. I received, from within Spellbinder Scientific, the DOS message "Write fault to device PRN, Abort Retry or Ignore". I punched *Abort* and was dumped immediately to DOS -- pretty harsh treatment for forgetting that a printer had been turned off. But overall, printing was a routine procedure with few surprises.

FINAL CONSIDERATIONS: With only a few exceptions, this was the kind of technical and scientific


This is an example of Spellbinder Scientific text
as well as the scientific and math character sets
within the program:
The above integrals, brackets, braces and radicals
are defined by the program already--you determine the size
and lengths while on screen, as simple as two carriage returns.

QUICK REFERENCE
PRODUCT:
Spellbinder Scientific
Lexisoft ,Inc.
P.O. Box 1950
Davis, CA 95617
(916)758-3630
SYSTEM REQUIREMENTS:
PC,XT, AT or compatibles with 256K and two floppy drives, a color graphics card or equivalent, Hercules, Everex, Tecmar or USI graphics cards. Also available for the AT&T PC 6300 and Dimension 68000 and the HP 150 Touchscreen computers.
PRINTERS SUPPORTED:
HP Laser Jet
FX-80, FX-100, MX-100, LQ1500
Santec-700
Toshiba 1340,1350,1351

word processor that didn't FEEL like a technical processor. Much of the smoothness of operation can be credited to Lexisoft's adherence to Spellbinder -- importing the "Scientific" into any already solid word processor. If you want one processor to do it all -- letters, regular manuscripts, and text, as well as technical documents --this system fits the bill. If you use chemical symbols, the building set provided here might be the deciding factor for you.

Be prepared, however. If you don't like Spellbinder as a word processor, you are not going to like it for technical and scientific text. I find some of Spellbinder's commands and routines a bit cumbersome for everyday use -- to save a file to disk, for instance, you must go to the top of the file, enter three keystroke commands and, finally, enter the filename. In fact, the entry and editing of the scientific equations might seem easier than mastery of the word processor itself.

SUMMARY: Spellbinder is easy to set up; equations are easy to enter and edit. On the whole this system is the most sophisticated technical and scientific character support available. With the exception of those aggravating modes and the dreadfully typeset manuals, I'd have to say it's the best all-around system available.

MASS-11

Before we end our MS-DOS search for a technical and scientific word processor, we must make at least one more stop: MASS-11. This side of a VAX, (and the other, for that matter) MASS-11 is a superior word processor. You can spend all day in MASS-11 and never leave the program, so complete are the available features. Split screen editing, vertical typing, column editing and entry, a four-function calculator that performs on either vertical OR horizontal entries,footnotes and headers, auto-embedded date and time in documents, extensive file and list sorts, a spelling checker that is accessible from WITHIN a text file, unerase and flexible cursor jumps (Advance by lines/pages = [F1] [N] n). I could keep going, the features available seem limitless, including cursor and point addressable graphics!

INSTALLATION: One simple batch file did the trick. I had to answer, as I recall, three questions. The program is big, but don't let that scare you -- it doesn't behave like a behemoth. The system comes on seven disks, including the start-up installation disk, printer drivers, spelling checker and dictionary and an example/tutorial disk.

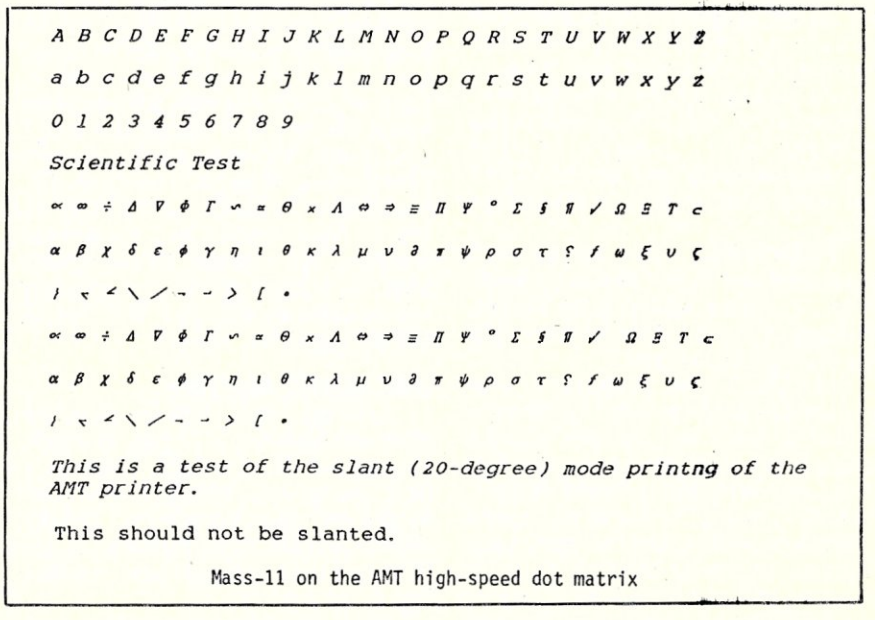
FEATURES: I've already mentioned, yet hardly covered, all of MASS-11's great "standard" word processor features (if only MOST of what MASS-11 has were on "standard" word processors!), but the technical and scientific text processing that is included is better than most. It doesn't have a font generator , but the included character set should be adequate for engineering, general math, and physics.

MASS-11, though an abundantly endowed processor, is never confusing to get around in. Most commands are performed in conjunction with the F1 key. The Greek and math character set is also accessed in this manner, i.e. F1 followed by G and the key representing the alternate character generates the character on-screen. MASS-11 opens up sections in the text for equation blocks, so that moving, reformating text, etc. are still easy to do. Sections of equations can be moved as well. A VERY comforting feature is MASS-11's ability to subscript and superscript in half and QUARTER spaces.

Dispite its size, MASS-11 is fast -- as it uses disk space as virtual memory pages. And there is safety in its size too; the program continually backs-up the file being edited into a disk *journal*: if there is a glitch, the file is backed-up. When the file is successfully edited and saved, the *journal* is then deleted, conserving space.

What's on the screen *IS EXACTLY* what you get. I had only one print sample -- a laser sample -- and thought it unfair to include a laser representation from only one program. The character set example is from an AMT high-speed dot matrix printer. All the characters are from DEC, the DECtech set in fact, with some addition by the MASS-11 folks.

DOCUMENTATION: Hands down, this is the best documentation I've seen for any word processing system. There is a User's Guide which details -- and I mean DETAILS -- every feature of the editor; a Printer Reference Manual which explains the characteristics, interfacing and capabilities of each printer that is supported. A Demo Guide takes you through the training disk; and, also included, is an easel-mounted desk QUICKREF that should be standard operating procedure for all software documentation. The QUICKREF takes up about six inches of desk space and has all the major (and most minor) commands with tips and explanations. The documentation is a boon to the bloodshot eye, elegantly typeset,


A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z
0 1 2 3 4 5 6 7 8 9
Scientific Test
This is a test of the slant (20-degree) mode printng of the AMT printer.
This should not be slanted.
Mass-11 on the AMT high-speed dot matrix

QUICK REFERENCE
PRODUCT:
MASS 11
Microsystems Engineering Corporation
2400 Hassel Road
Suite 400
Hoffman Estates,IL 60195
(312)882-0111
SYSTEM REQUIREMENTS:
PC,XT,AT or compatibles DOS 2.xx or higher with at least 320K RAM, two floppies and the enhanced graphics or Hercules monochrome adapter cards. Hard disk is required for graphics support. The DEC Rainbow with the above requirements. Also available on the VAX and MicroVAX. PRINTERS **SUPPORTED:**
DEC LA50
IBM Graphics
AMT (Advanced Matrix Technology)
Diablo 630 and 630 ECS
Digital LQP02
Qume
NEC (daisy wheel models)
Epson FX, MX
Digital LN01, LN01S, LN03
Talaris 800, 810, 1200, 2400
QMS 800, 1200, 2400
XEROX 2700, 9700 (with Datalogics
typesetting software) HP Laser Jet (Not DECtech set)
note: Check font sets available, especially for DEC printers used with MASS 11.
PRICE:
$995 for seven disk system and one free update. Educational price is $500.

printed on heavy rag bond and set into full-sized binders. Content and quality are superb. It seems strange to me that more word processing software vendors don't spend the time to produce quality documentation, especially WORD processing companies.... And if the documentation isn't enough, MASS-11 has extensive on-line, menu-driven help.

PRINTING: After setting such Document and Print defaults as footer lines, margins and printer driver. Printing is just a matter of answering the prompt: file to print?

MASS-11 also supports a very professional print/editing option: redlining. Let's say you have edited a document and made numerous deletions. With the redlining feature, MASS-11 will print out those deleted characters, words, lines or paragraphs with an overprint through each; in essence, you can review what you've cut BEFORE you make the final and irrevocable editing decisions. You can restore what you want before a final print run. This is superbly suited to preparing final, edited text -- and is an invaluable feature for working with book-length and publication-ready manuscripts.

FINAL CONSIDERATIONS: Another plus in MASS-11 is its ability to send and receive files from VAX. This gives the program enormous power. If you have access to a VAX on the premises or through a dial-up, you *will* want MASS-11. Use of the computer as a terminal from within MASS-11 is a big bonus -- as I said, there seems to be little reason to ever return to DOS.

At this time, however, there is just the DECtech character set available. This may pose a problem for some -- check the set beforehand. MEC has found some limitations when using any of the Digital printers, also. Check with MEC.

SUMMARY: If you have a small to large office environment that does heavy word processing with standard technical and scientific characters, get MASS-11...you'll never outgrow it. In fact, if the system will be used for extensive manuscripts, and you use a VAX in the office, I can't think of why you would avoid purchasing MASS-11. The graphics and its ability to import graphics from other sources into your text are features other word processors are still struggling with.

CONCLUSIONS

By all indications the products I've reviewed and those still to be released will continue to improve in performance and versatility.

In fact, I'm confident that many of these programs may blossom into fully integrated packages which would do away with the whole moniker *technical and scientific* word processor. Imagine, just one system that processes words -- technical or otherwise -- with a minimum amount of keyboard calisthenics. Programs such as T3, Spellbinder Scientific and MASS 11 are on that track, and they bear watching. As it stands, no one system seems to address all the myriad needs and possible applications. But they're getting close, real close.

LAST MINUTE ADDITION

Arriving just in time for a studied peek was Hockney's Egg by Perrigrin Falcon, Inc. That's right, Hockney's Egg...seems this Professor Hockney wanted to type equations in an orderly manner and see them displayed on his PC screen the way they'd print. And the Egg is the product.

The Egg installed fast, no questions asked other than if the installation would take place on a hard or floppy disk. The program itself, including font sets, is right at 200k. And an amazing 200k it is.

QUICK REFERENCE
PRODUCT:
Hockney's Egg
The Perrigrin Falcon Company
P.O. Box 2023
Mill Valley, CA 94942**SYSTEM REQUIREMENTS:**
256K PC,XT or compatible with two floppies and a color graphics or Hercules graphics card.**PRINTERS SUPPORTED:**
Diablo 630
Toshiba 1351, P351
Epson FX-80 and work-a-likes
Apple LaserWriter
PRICE:
$595 for system and fonts disk, three manuals.

Besides being slim, the Egg is fast -- fast to read and write, fast to get running, easy to use. I didn't even crack open the documentation until I wanted to know about the embedded print commands. A card detailing all the major commands was all I needed to enter, edit, move and block move, skip through the 700+ character fonts and to get to the character generator and editor.

The Egg may be light on some regular word processing features such as auto indexing, a spelling checker or mail merge, but if you want a word processor for your technical text that takes virtually an hour or two to learn, has all the features you need to edit, enter and modify alternate character sets, Hockney's Egg is a good choice. Macros make entry of large math or chemical constructions as effortless as punching up a Function key. And if you don't like the sets that are pre-defined when you purchase the Egg, it's a simple matter to reprogram all thirty keys to whatever you wish -- including regular text editing functions.

Perhaps the most exciting and innovative aspect of Hockney's Egg is what is to be released in the next version: the ability to directly drive the Line-a-tron 202 or 101 composing machines. Technical and scientific manuscripts are among the most costly to typeset ($45-$70 per page, as I understand). By having a word processor that can directly address the manuscript's own typeset ting needs, costs would be drastically reduced.

The font sets which are provided are more than adequate for a variety of technical, engineering, and scientific manuscripts. If not, the font editor is available to create whatever character you might need or dream up.

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—David Obregón, *PC Magazine*

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Steven Bosak lives in Evanston Illinois and is a freelance writer/editor who has worked on everything from technical writing to fiction. His novel, titled "Gammon" has just been published by St. Martins/Marek Press.

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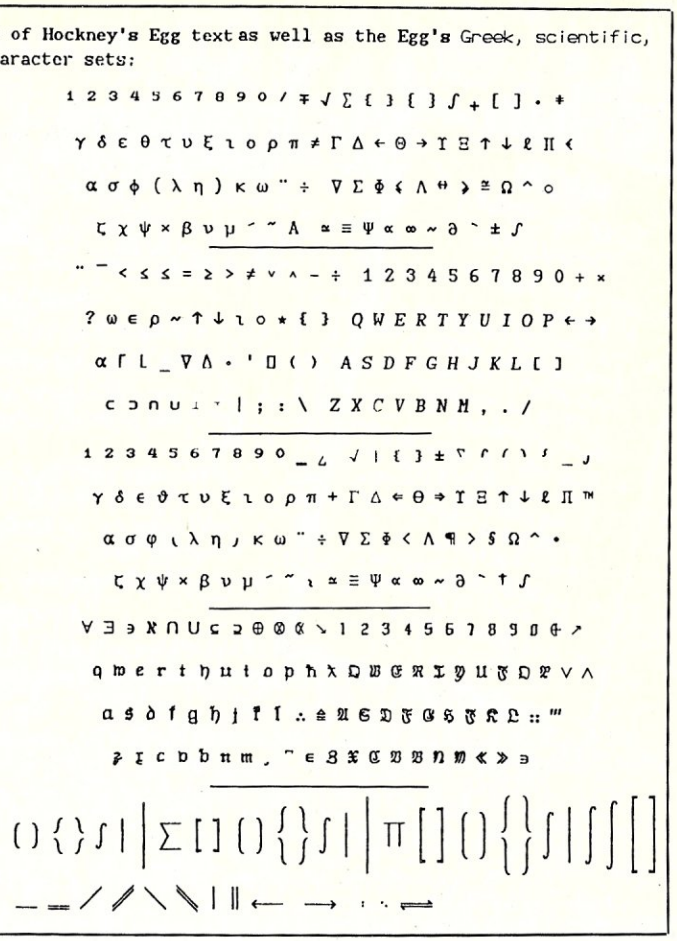

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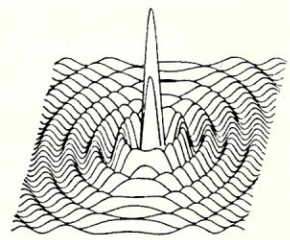

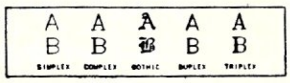

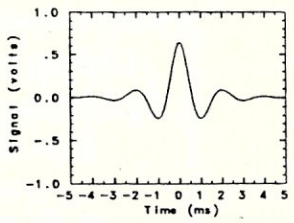

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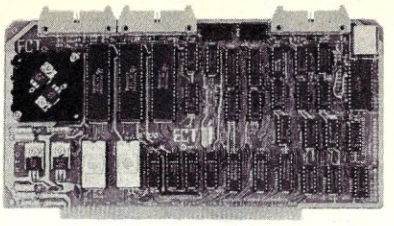

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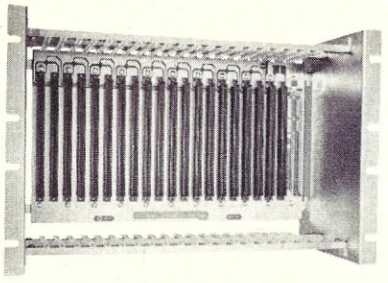

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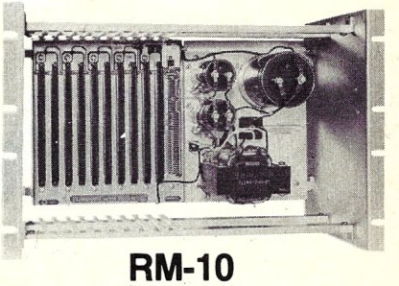

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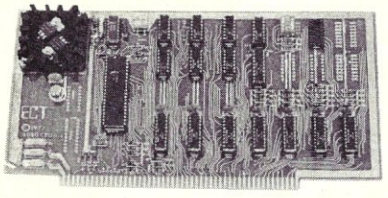

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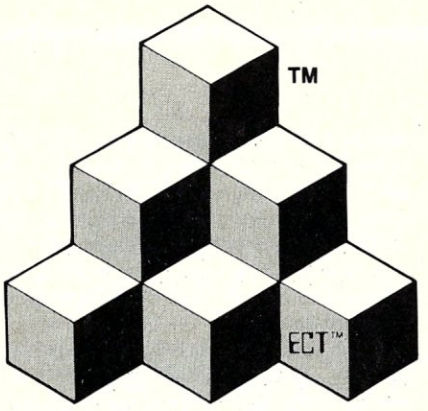

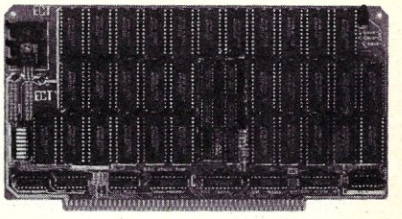

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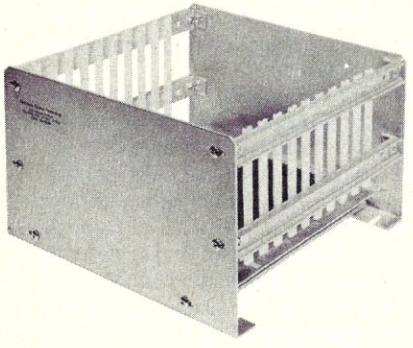

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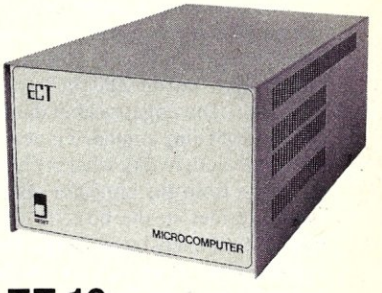

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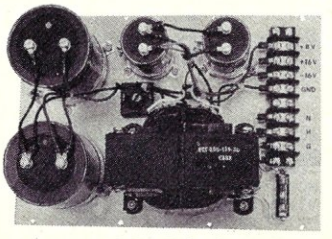

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BUILD AN S-100 EPROM EMULATOR

by Robert A. Rioja

INTRODUCTION

Computers are often used to create new computers and circuits. One way to do this is to use an existing computer (the *host*) to *emulate* all or part of the one being developed (the *target*). One such technique is called *In-Circuit Emulation*, or *ICE*. This involves building into the host, a circuit (the *emulator*) which emulates a part of the target, such as its processor, memory, etc., and connecting it to the target via cables. The ends of the cables are terminated with connectors that are physically identical to the components being emulated.

For example, if a particular ICE emulates a 40-pin processor such as a Z80, its cable would end in a 40-pin connector which plugs into the Z80 socket in the target computer. The target system thinks that the component being emulated is actually plugged in when in reality what is plugged in, is the cable from the emulator. Because this circuit resides in the host, it can be controlled completely by the host computer and is guaranteed to work, even if the target is incomplete or malfunctioning. Such ICE circuits are readily available for some computers but are not as common for S-100 systems.

OUR EMULATOR

The circuit described in this article is an S-100 board that emulates a number of EPROMs. This means that if you are developing software designed to reside in an EPROM, you can load the software into the emulator and connect its cable to the EPROM socket in your circuit. Now you can test the software on your target, debug it, and make changes or corrections any number of times without having to program, erase with ultraviolet light, and reprogram an EPROM. Once you are satisfied that your software is correct, you can program it into the EPROM, unplug the emulator, plug in the EPROM, and enjoy the fruits of your labor. If you design a lot of EPROM based software, the time you spend building this emulator may be miniscule compared to the time you would have to spend erasing and reprogramming EPROMs while debugging your software.

The emulator consists of up to two memory components each of which emulates one EPROM. Thus you can emulate up to two EPROMs simultaneously! The memories used are eight x 8-k RAMs of eight kilobyte capacity each. This will allow you to emulate any combination of 2708 (1K), 2716 (2K), 2732 (4K), and 2764 (8K) EPROMs. Since the two memories work independently, they can emulate two EPROMs of the same type or of different types. For example, one memory might be used to emulate a 2764 while the other a 2716. The only restriction is that both EPROM sockets in the target MUST share common address and data buses. This is normally the case and should not be a problem. More than one emulator can be used at the same time to emulate more EPROMs if needed. The emulator has two cables coming from it to plug into the EPROM sockets in the target.

The circuit is connected to the S-100 bus through six consecutive output ports. No input ports are used, since data is only sent to the emulator and never read from it. Only the target reads the data from the emulator, but it does so through the cables. The actual port assignments are set by an on-board DIP switch. They are:

PORT	FUNCTION
0	SET EMULATOR TO LOAD MODE
1	SET EMULATOR TO EMULATE MODE
2	LEAST SIGNIFICANT BYTE OF ADDRESS
3	MOST SIGNIFICANT BYTE OF ADDRESS
4	WRITE DATA TO FIRST MEMORY
5	WRITE DATA TO SECOND MEMORY

BASIC OPERATION

The operation of the emulator can be summarized by the following four steps:

1. Set emulator to "load" mode.
2. Load into the emulator the data that would normally reside in the EPROM.
3. Set the emulator to "emulate" mode.
4. Reset and run the target system.

To perform step 1, a byte is output to port 0. The actual data sent is not important, the only thing that matters is that port 0 be addressed. This step disconnects the emulator from the target and connects the memories to the S-100 bus.

In step 2, for each byte of data you want to load into the memory, three bytes must be output to three ports. First the address of the byte as it would reside in the EPROM must be sent. This is done by outputting the low byte of the address to port 2, and the high byte of the address to port 3. The order in which this is done is not important. Then the actual data byte must be sent to either port 4 or 5 depending on which of the two memories you want to access.

Step 3 is similar to step 1 and is performed by outputting a byte to port 1. Again, the actual byte is not important as long as port 1 is addressed. This step disconnects the emulator's memories from the S-100 bus and connects it to the target.

SOFTWARE CONSIDERATIONS

Listing 1 is a short Z80 sample program for loading three bytes into the first memory. Let us assume that the program to be loaded into the emulator resides at host address 1000H and is to be loaded into the first EPROM starting at EPROM location 200H.

A more complete program appears in listing 2. It was written in Z80 assembly language and assembled with the Microsoft M80 assembler. Any monitor that can out-

put to I/O ports can also be used to access the emulator directly.

HARDWARE CONSIDERATIONS

The emulator board is addressed by the S-100 host through the first six of eight consecutive output ports. Since the board ignores the last two ports, they could be used by another board in the system. The emulator board contains a six switch DIP module. Switches 1 to 5 set the high-order bits of the port address.

The address and data lines to the target are brought through the cable for memory 1 only. This is why the two EPROMS in the target must have common address and data buses. Memory-1 shares its address and data buses with memory-2. If each memory were connected to the address and data buses of the target, these buses would have two cables connected to them instead of one. This would mean twice the loading and much more noise on the buses, as cables are actually antennae capable of picking up stray electrical noise and bringing it to the bus.

The cable for memory-2 carries only the control signals for chip select. Although both cables must have a ground connection, the power line, Vcc, is not needed since the board receives power from the S-100 bus. If only one EPROM is being emulated, memory 1 should be used and memory 2 should be turned off. This is done by closing DIP switch 6.

CONSTRUCTION

The circuit contains only thirteen ICs and can easily be wire-wrapped. Each IC should have a 0.01-uF capacitor connected across +5v and ground. Assemble the two cables to emulate the EPROMs you want to emulate. One end of the cable is plugged into the emulator, while the other end is soldered to a header and plugged into the EPROM socket.

Cable 1 can be wired point-to-point or it can be assembled with a mass-termination header. Cable 2 is best wired point-to-point since it only needs three wires as shown in Table 1. Table 2 lists the point-to-point wiring for cable 1 for the different EPROMs.

Robert A. Rioja is an electrical engineer and educator with over 15 years in electronics and computers. An active consultant, he is the founding president of Superior Control Systems. He has designed and built custom-made computers used by several government agencies, as well as private industry. Most of his designs are based on the S-100 bus and a proprietary CP/M-compatible, multiprocessing operating system. He can be contacted at 166 Wright St, Staten Island, NY 10304, (718) 442-0665.

LISTING 1

```
        LD   HL,1000H     ;WHERE DATA RESIDES
        LD   DE,0200H     ;WHERE SHOULD RESIDE IN EPROM
        LD   B,3          ;NUMBER OF BYTES OF DATA

        OUT  (PORT0),A    ;PUT EMULATOR IN LOAD MODE
LOOP:
        LD   A,E          ;SEND LOW BYTE ADDRESS
        OUT  (PORT2),A
        LD   A,D          ;SEND HIGH BYTE ADDRESS
        OUT  (PORT3),A

        LD   A,(HL)       ;GET DATA BYTE
        OUT  (PORT4),A    ;SEND TO FIRST MEMORY

        INC  HL           ;INCREMENT DATA POINTER
        INC  DE           ;INCREMENT EPROM ADDRESS

        DJNZ LOOP         ;LOOP UNTILL FINISHED

        OUT  (PORT1),A    ;PUT EMULATOR IN EMULATE MODE
```

LISTING 2

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                                                      ;
;     THIS PROGRAM DRIVES S-100 EPROM EMULATOR.        ;
;     IT ASKS YOU FOR NAME OF FILE TO LOAD             ;
;     INTO EMULATED EPROM AND NUMBER OF                ;
;     PROM (1 OR 2).  FILE MUST CONTAIN A MEMORY       ;
;     IMAGE OF WHAT YOU WANT EPROM TO CONTAIN.         ;
;     ONCE FILE IS LOADED, TARGET SYSTEM               ;
;     MUST BE RESET BEFORE READY TO RUN.               ;
;                                                      ;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

        .Z80

;       IO PORTS

;       SET THE BASE ADDRESS TO WHATEVER YOU WANT

BASE    EQU     0F8H            ;BOARD ADDRESS BASE
EMODE   EQU     BASE            ;EMULATE MODE
LMODE   EQU     BASE+1          ;LOAD MODE
LATCHL  EQU     BASE+2          ;LATCH LOW BYTE
LATCHH  EQU     BASE+3          ;LATCH HIGH BYTE
WRITE0  EQU     BASE+4          ;WRITE TO ROM 0
WRITE1  EQU     BASE+5          ;WRITE TO ROM 1

;       SYSTEM ADDRESSES

BOOT    EQU     0               ;REBOOT
DOS     EQU     5               ;DOS ENTRY POINT
FCB     EQU     5CH             ;FCB ADDRESS
CONBUF  EQU     80H             ;CONSOLE BUFFER ADDRESS

;       SYSTEM FUNCTIONS

PRTSTR  EQU     9               ;PRINT STRING
RDBUFR  EQU     10              ;READ CONSOLE BUFFER
OPNFIL  EQU     15              ;OPEN FILE
RDSEC   EQU     20              ;READ SEQUENTIAL SECTOR
SETIOA  EQU     26              ;SET IO ADDRESS

;       ASCII

LF      EQU     0AH             ;LINE FEED
CR      EQU     0DH             ;CARRIAGE RETURN
SPACE   EQU     20H             ;SPACE

START:  LD      SP,STACK        ;SET STACK POINTER

GETFIL: LD      DE,FILMSG       ;ASK FOR FILE NAME
        CALL    PRTMSG
        CALL    GETANS          ;GET ANSWER
        JR      Z,GETFIL        ;REPEAT IF NO ANSWER
        LD      HL,CONBUF+2
        LD      BC,FCB
        CALL    MAKFCB          ;PREPARE FCB
        JR      Z,FCBOK         ;JUMP IF FCB OK
        LD      DE,BADFIL       ;ELSE PRINT ERROR MESSAGE
        CALL    PRTMSG
        JR      GETFIL          ;AND START AGAIN

FCBOK:  LD      DE,FCB          ;OPEN FILE
        LD      C,OPNFIL
        CALL    DOS
        INC     A               ;TEST FOR OPEN ERROR
        JR      NZ,OPENOK
        LD      DE,OPNMSG       ;PRINT OPEN ERROR MESSAGE
        CALL    PRTMSG
        JR      GETFIL

OPENOK: LD      DE,SECBUF       ;SET IO ADDRESS TO SECTOR BUFFER
        LD      C,SETIOA
        CALL    DOS
        LD      DE,FCB          ;READ FIRST RECORD
        LD      C,RDSEC
        CALL    DOS
        OR      A
        JR      Z,GETROM        ;JUMP IF READ OK
        LD      DE,EMPMSG       ;PRINT FILE EMPTY MESSAGE
        CALL    PRTMSG
        JR      GETFIL

GETROM: LD      DE,ROMMSG       ;ASK FOR WHICH EPROM
        CALL    PRTMSG
        CALL    GETANS          ;GET ANSWER
        CP      1               ;MUST BE ONLY 1 CHARACTER
        JR      NZ,GETROM
        LD      A,(CONBUF+2)    ;GET THE CHARACTER
        CP      '1'             ;TEST FOR FIRST EPROM
        JR      Z,SET1
        CP      '2'             ;TEST FOR SECOND EPROM
        JR      NZ,GETROM

SET2:   LD      C,WRITE1        ;SET FOR SECOND EPROM
        JR      SET
```

Table 1

EMULATOR CONNECTOR	HEADER			
	2708	2716	2732	2764
1	12	12	12	14
2	18	18	18	20
3	20	20	20	22

Parts List

U1,U11,U12,U13	81LS95	Octal buffer
U2	25LS2521	8 bit comparator
U3	74LS138	3-to-8 decoder
U4	74LS00	Quad NAND gate
U5, U6	74LS374	Octal D flip flop
U7, U8	6264	8K X 8 RAM
U9	74LS32	Quad OR gate
U10	74LS08	Quad AND gate

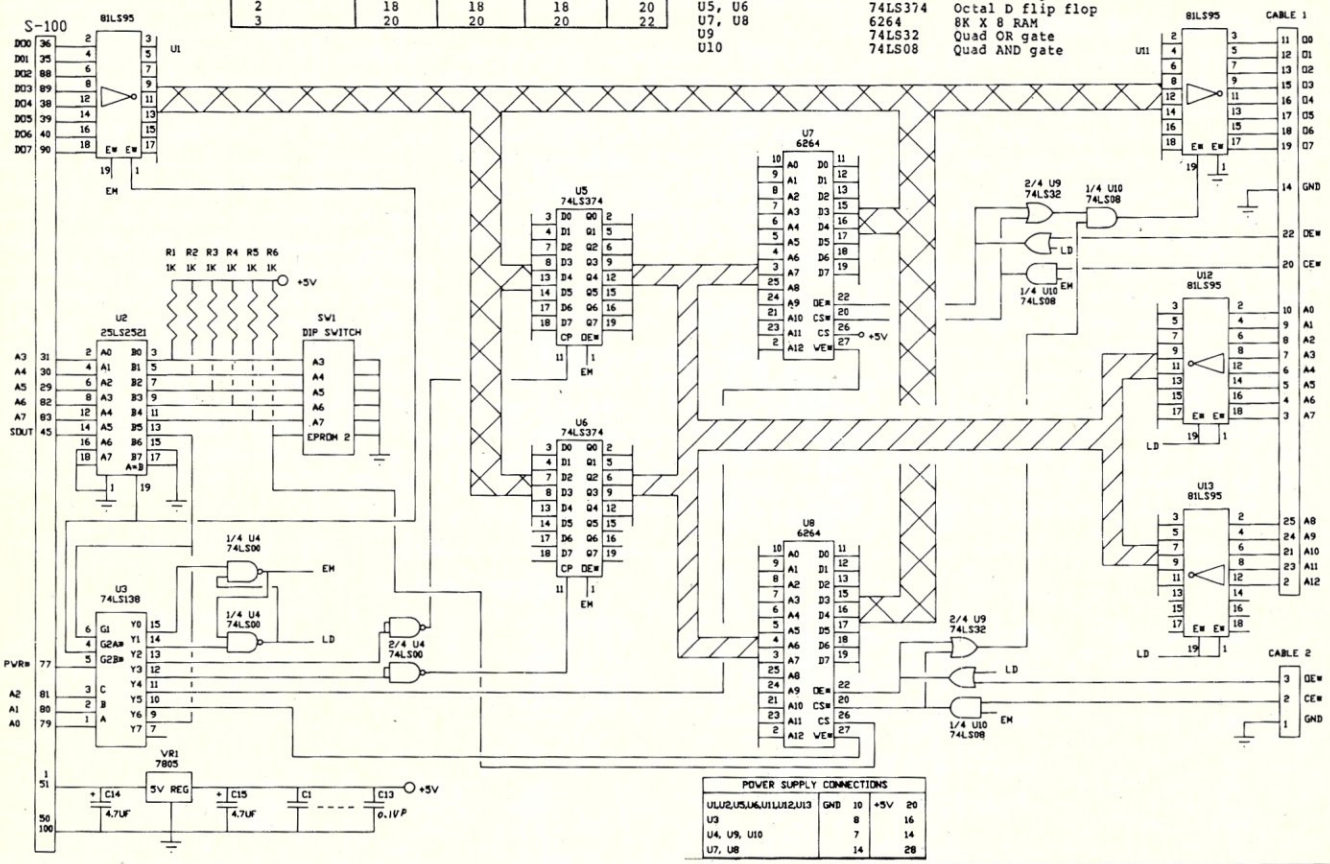

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Table 2

EMULATOR CONNECTOR	HEADER			
	2708	2716	2732	2764
1	NC	NC	NC	NC
2	NC	NC	NC	2
3	1	1	1	3
4	2	2	2	4
5	3	3	3	5
6	4	4	4	6
7	5	5	5	7
8	6	6	6	8
9	7	7	7	9
10	8	8	8	10
11	9	9	9	11
12	10	10	10	12
13	11	11	11	13
14	12	12	12	14
15	13	13	13	15
16	14	14	14	16
17	15	15	15	17
18	16	16	16	18
19	17	17	17	19
20	18	18	18	20
21	12	19	19	21
22	20	20	20	22
23	12	21	21	23
24	22	22	22	24
25	23	23	23	25
26	NC	NC	NC	NC

```
SET1:   LD      C,WRITE0        ;SET FOR FIRST EPROM

SET:    OUT     (LMODE),A       ;SET TO LOAD MODE
        XOR     A               ;CLEAR ADDRESS LATCHES
        OUT     (LATCHH),A
        OUT     (LATCHL),A
        LD      DE,0            ;DE = EPROM ADDRESS

READLP: LD      HL,SECBUF       ;POINT TO SECTOR BUFFER
        LD      B,128           ;128 BYTES PER SECTOR

SENDLP: LD      A,(HL)          ;GET A BYTE OF DATA
        OUT     (C),A           ;SEND IT TO THE PROPER EPROM
        INC     HL              ;INCREMENT DATA POINTER
        INC     E               ;INCREMENT LOW BYTE OF ADDRESS
        LD      A,E             ;SEND IT OUT
        OUT     (LATCHL),A
        JR      NZ,NOHI         ;JUMP IF NO CARRY
        INC     D               ;INCREMENT HI BYTE OF ADDRESS
        LD      A,D             ;SEND IT OUT
        OUT     (LATCHH),A
NOHI:   DJNZ    SENDLP

        EXX
        LD      DE,FCB          ;READ NEXT RECORD
        LD      C,RDSEC
        CALL    DOS
        OR      A               ;JUMP IF END OF FILE
        JR      NZ,EOF
        EXX
        JR      READLP

EOF:    OUT     (EMODE),A       ;SET TO EMULATE MODE
        JP      GETFIL

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                                                                              ;
;       ROUTINE TO SEND CR AND LF TO CONSOLE                                   ;
;                                                                              ;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
PCRLF:  LD      DE,CRLF

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                                                                              ;
;       ROUTINE TO SEND A MESSAGE TO CONSOLE.                                  ;
;       ADDRESS OF MESSAGE MUST BE IN REGISTER DE.                             ;
;                                                                              ;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
PRTMSG: LD      C,PRTSTR
        JP      DOS

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                                                                              ;
;       ROUTINE TO WAIT FOR AN ANSWER FROM CONSOLE                              ;
;                                                                              ;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
GETANS: LD      HL,CONBUF       ;POINT TO CONSOLE BUFFER
        LD      B,20            ;SET BUFFER LENGTH
        LD      (HL),B
        INC     HL
        LD      (HL),0          ;CLEAR CURRENT LENGTH
GA1:    INC     HL
        LD      (HL),0          ;CLEAR BUFFER
        DJNZ    GA1
        LD      DE,CONBUF       ;READ CONSOLE BUFFER
        LD      C,RDBUFR
        CALL    DOS
        CALL    PCRLF           ;PRINT CR AND LF
        LD      A,(CONBUF+1)    ;GET CURRENT LENGTH
        OR      A
        RET

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                                                                              ;
; "MAKFCB" MAKES FCB AT (BC) FROM ASCII STRING AT                              ;
;  AT (HL).  RETURNS A=0 IF NO ERROR.                                          ;
;                                                                              ;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
MAKFCB: LD      A,(HL)          ;FIND FIRST NON BLANK
        OR      A
        JR      Z,WHAT?         ;ALL SPACES?
        CP      CR
        JR      Z,WHAT?
        CP      SPACE
        JR      NZ,NONSP
        INC     HL
        JR      MAKFCB

ILEGAL: POP     HL
WHAT?:  OR      0FFH            ;ERROR RETURN
        RET

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                                                                              ;
; "LEGAL" CHECKS FOR LEGAL CHARACTERS IN A                                     ;
;  STRING POINTED AT BY DE AND ENDING WITH 0.                                  ;
;                                                                              ;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
LEGAL:  LD      A,(DE)
        OR      A
        RET     Z
        CP      SPACE
        JR      C,ILEGAL
        RET     Z
        EXX
        LD      HL,LGLCHR
        LD      BC,7
        CPIR
        EXX
        RET

NONSP:  PUSH    BC              ;SAVE FCB ADDRESS
        LD      B,14
        PUSH    HL              ;SAVE STRING ADDRESS
UCLOOP: LD      A,(HL)          ;TRANSLATE TO UPPER CASE
        OR      A
        JR      Z,MADEUC
        CP      CR
        JR      Z,MADEUC
        CP      'a'
        JR      C,UPCASE
        CP      'z'+1
        JR      NC,UPCASE
        RES     5,(HL)
UPCASE: INC     HL
        DJNZ    UCLOOP
MADEUC: POP     DE              ;DE=STRING ADDRESS
        POP     HL              ;HL=FCB ADDRESS
        LD      (FCBADD),HL     ;SAVE FCB ADDRESS
        LD      A,(DE)          ;GET FIRST CHARACTER
        OR      A               ; FROM THE BUFFER
        JR      Z,DEFALT        ;JUMP IF ZERO

; SEE IF FIRST TWO CHARS ARE A DRIVE NAME
; AND A COLON.  WE ASSUME IT IS AND CONVERT
; DRIVE NAME TO A NUMBER BY SUBTRACTING "@"
        SBC     A,40H
        LD      B,A             ;SAVE POSSIBLE DRIVE NUMBER
        INC     DE              ;GET SECOND CHARACTER
        LD      A,(DE)          ; FROM BUFFER
        CP      ':'             ;TEST FOR COLON
        JR      Z,NEWDSC        ;JUMP IF SO
        DEC     DE              ;ELSE BACK UP TO FIRST CHAR

; IF DRIVE NOT SPECIFIED, USE DEFAULT DISC
DEFALT: LD      (HL),0          ;PUT IT INTO FCB
        JR      MAKNAM

; IF DRIVE SPECIFIED, USE IT
NEWDSC: LD      (HL),B          ; PUT IT INTO FCB
        INC     DE              ;POINT TO NEXT CHAR

; ASSUME NEXT WORD IN COMMAND
; IS A FILE NAME SO PUT IT INTO FCB.  IF
; FIRST WORD WAS NOT A FILE NAME THEN THIS WILL
; HAVE BEEN DONE FOR NOTHING BUT NO HARM WAS DONE.
MAKNAM: LD      B,8             ;B=8 CHARACTERS IN FILE NAME
NAMELP: CALL    LEGAL           ;CALL ROUTINE TO CHECK FOR
                                ;ILLEGAL CHARACTERS IN FILE NAME
```

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```
        JR      Z,NAMESP        ;JUMP ON ERROR
        INC     HL              ;POINT TO NEXT FCB POSITION

; NOW CHECK FOR * AND IF FOUND FILL WITH ?
        CP      '*'             ;CHECK FOR *
        JR      NZ,NAMEUA       ;JUMP IF NOT
        LD      (HL),'?'        ;ELSE PUT ? IN FILE NAME
        JR      NAMEAM

NAMEUA: LD      (HL),A          ;PUT CHARACTER IN FCB FILENAME
        INC     DE              ;POINT TO NEXT CHARACTER
NAMEAM: DJNZ    NAMELP          ;LOOP AROUND

; KEEP READING UNTIL ILLEGAL CHARACTER OR PERIOD IS FOUND
; BUT DO NOT PUT INTO FCB
ENDNAM: CALL    LEGAL
        JR      Z,MAKTYP
        INC     DE
        JR      ENDNAM

NAMESP: INC     HL              ;COME HERE IF ILLEGAL CHARACTER
        LD      (HL),SPACE      ; FOUND. FILL REST OF FCB
        DJNZ    NAMESP          ; FILENAME WITH SPACES

; REPEAT FOR FILETYPE WHAT WE DID FOR FILENAME

MAKTYP: LD      B,3             ;B=3 CHARACTERS IN FILETYPE
        CP      '.'             ;SEE IF ILLEGAL CHAR IS "."
        JR      NZ,TYPESP       ;IF NOT, FILL TYPE WITH SPACES
        INC     DE              ;ELSE POINT TO NEXT CHARACTER
TYPELP: CALL    LEGAL           ;CHECK FOR ILLEGAL CHARACTER
        JR      Z,TYPESP        ;JUMP IF ILLEGAL
        INC     HL              ;ELSE POINT TO NEXT CHARACTER
; NOW CHECK FOR * AND IF FOUND FILL WITH ?
        CP      '*'             ;CHECK FOR *
        JR      NZ,TYPEUA       ;JUMP IF NOT
        LD      (HL),'?'        ;ELSE PUT ? INTO FCB
        JR      TYPEAM

TYPEUA: LD      (HL),A          ;PUT CHARACTER IN FCB FILETYPE
        INC     DE              ;POINT TO NEXT CHARACTER
TYPEAM: DJNZ    TYPELP          ;LOOP AROUND

; KEEP READING UNTIL ILLEGAL CHARACTER OR PERIOD FOUND
; BUT DO NOT PUT INTO FCB
ENDTYP: CALL    LEGAL
        JR      Z,MAKEXT
        INC     DE
        JR      ENDTYP

TYPESP: INC     HL              ;COME HERE IF ILLEGAL CHARACTER
        LD      (HL),SPACE      ; FOUND.  FILL REST OF
        DJNZ    TYPESP          ; FILETYPE WITH SPACES

MAKEXT: LD      B,21            ;FILL NEXT 21 BYTES
EXTLP:  INC     HL              ;IN FCB WITH 0
        LD      (HL),0
        DJNZ    EXTLP

; RETURN WITH B=NUMBER OF "?" IN FILE NAME.
; USED TO CHECK FOR AMBIGUOUS FILE REFERENCES.
        LD      HL,0            ;RECOVER START OF FCB
FCBADD  EQU     $-2
        LD      BC,11
AMBIG?: INC     HL
        LD      A,(HL)
        CP      '?'
        JR      NZ,AMBIG1
        INC     B
AMBIG1: DEC     C
        JR      NZ,AMBIG?

        XOR     A               ;NO ERROR RETURN
        RET

LGLCHR: DEFM    '=_.:;<>'


FILMSG: DEFB    CR, LF, 'FILE NAME: $'
BADFIL: DEFB    CR, LF, 'INCORRECT FILE NAME.$'
OPNMSG: DEFB    CR, LF, 'CANNOT OPEN FILE.$'
EMPMSG: DEFB    CR, LF, 'FILE IS EMPTY.$'
ROMMSG: DEFB    CR, LF, 'WHICH EPROM? (1 OR 2): $'
CRLF:   DEFB    CR, LF, '$'

STACK   EQU     $+20
SECBUF  EQU     STACK+1

        END
```

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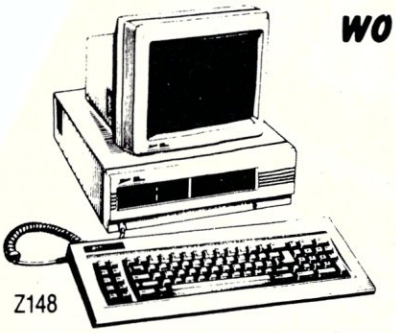
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Intersystem Processing

by Hank Volpe

A Terminal Emulator & File Transfer Program Between CP/M & MS-DOS Systems

Ever wondered what makes a terminal emulator program go? Some of these programs can be rather expensive, but if you know a few hardware and software tricks, you can open up a new horizon for yourself and your computer system.

My "computer-room" consists of an IMSAI-8080 (which is more of a North Star Horizon) using the CP/M 2.2 operating system and an IBM-PC. My interest in developing emulator software emerged quite suddenly when my 10 year old Hazeltine 1500 went up in a pretty blue puff of smoke one winter evening. I figured this was the perfect opportunity to try to make the PC run the S-100 system. With a little more work, I wrote this emulator to do file transfers between the two systems, and some multiprocessing. The program consists of two parts. Part one is the Hazeltine emulator. This section handles all the communications and hardware "handshaking" between the two systems. Part two is the file transfer section which requires a program be loaded in the S-100 system computer in order to make the file transfer process as simple as possible.

Before we get started on the software, it is important to explain some of the hardware involved and how the software routines control the hardware.

LOOKING AT THE HARDWARE

Although parts of this section deal specifically with my IMSAI system, you should realize that all serial data equipment communicates in a similar manner. I know that the North Star Horizon computers and many other S-100 systems use a similar configuration. But even if your hardware is different, it still uses the method described here to communicate. For a device to talk to another device, it must know three things: 1) that the device it is trying to talk to is on-line, 2) that the device it is trying to talk to knows that it is on-line, and 3) when it can or can't transmit or receive data. This is not very complex or exotic, but it does require a peek into how a computer communicates with a terminal.

Most S-100 computers use a serial interface to crt's. My IMSAI is equipped with an IMSAI S-I/O board. This board supports two serial I/O channels using twin Intel 8251A USARTS. Each serial channel uses 2 ports. One port, in each channel, is used for Data I/O, and the other to program the 8251A and read its line status.

When the IMSAI is cold-booted, a terminal initialization routine in the BIOS module programs this chip for the correct start/stop bits, parity, and baud rate factor. Whenever a program or operating system requests communication with the system terminal, the CPU uses the program/channel port to test the status of certain data line conditions. If you are familiar with implementing CP/M on your system, you have probably been exposed to the software polling techniques that examine the line status registers to see if data is ready to be received or transmitted.

In the PC, external communications occur in a similar manner, except for the fact that the keyboard is not an external device, but an interrupt driven device that uses program memory for its buffering and a memory mapped display for its visual display. Therefore, unless already furnished, you will have to buy a RS-232 Asynchronous Adaptor. Some multifunction boards already come with a serial port, or you can buy a stand-alone unit for under $100.

Although the hardware itself is installed simply by inserting the board in the PC and hooking up the cable to the crt port of the IMSAI, the way the software controls this hardware needs to be understood. "Handshaking," i.e., communications between the terminal and the computer are sometimes visible to the software (as in CP/M BIOS modules) or invisible (done by the terminal hardware). If a serial port is linked to a modem, a standard group of control signals are used which inform the modem that the computer wishes to transmit or is ready to receive data over the serial link. Serial devices communicate using the standard modem handshaking signals; DSR (Data Set Ready), DTR (Data Terminal Ready), RTS (Request To Send), and CTS (Clear To Send). When these signals are used by serial data terminals, they are used in a slightly different manner.

DSR and DTR are considered as one pair of handshaking signals, RTS and CTS as another pair. When used with a modem, a terminal will receive the Data Set Ready (DSR) signal from the modem as an indication that the modem has received a Data Terminal Ready (DTR) signal from the terminal. When used with a terminal, the DTR output of one device is connected to the DSR input of the other. This satisfies conditions 1 & 2 above.

Next is the RTS/CTS signal pair. When used with a modem, the Clear To Send (CTS) signal is supplied to the computer to indicate that it is permissible to begin the transmission of a message. When used with a terminal, the Request To Send (RTS)output signal of one unit is connected to the Clear To Send input of the other.

The thing to watch out for here is exactly which pair in your computer handle the "handshaking." There is no reason why the DSR/DTR pair or the RTS/CTS pair separately or together could not handle the handshaking process. There are several ways to find out.

First, if you are good at reading logic diagrams, check if a valid RTS signal is needed to enable your S-100 USART. This is the way my 8251A USARTS operate. Whenever a valid CTS signal is received, it enables the 8251A to transmit. Your system, however, may look for a valid DSR/DTR handshake instead.

If you can't read a logic diagram, take a look at the CP/M BIOS module for your S-100 computer. Most venders provide a BIOS listing. When the BIOS performs its terminal polling routines, look to see if it ''masks'' for a valid DSR signal (comments regarding the mask should be either in equates or in the comment field of the assembler routine). If no test is made, then your system probably uses RTS/CTS. If you really want to be safe, write the software to control both !

THE PC CONTROLLING PROGRAM

When used as a terminal emulator, the PC replaces my existing terminal. Although it is a little like using an M-16 to go rabbit hunting, it allows me to continue to run and develop programs on the IMSAI that for reasons of specific hardware needs cannot be run on the PC.

To exchange files requires both systems to run a file exchange program. The goal of this part of the program is to make the exchange as invisible to the user as possible. All the user should have to do is select which way the files are to be transferred, type in the file name, and then sit back and watch the show !

Now that we have mapped out what to do, how its done, and what we need, it is time to take a look at the actual program and how it works.

The PC program is called COMM.COM (no puns intended). It is written in Turbo Pascal. I selected this as the language (over an assembler) for two reasons: 1) Turbo Pascal allows the programmer access to the computer hardware in a manner similar to an assembler while offering a high-level file access system that would make it easier to do file exchanges, and 2) I have both Z-80 and 8088 versions of Turbo Pascal in the IMSAI and PC computer systems. If you feel that you would be more comfortable using an assembler, you can easily translate the procedures dealing with communications between the two systems.

The CONST section of the program equates program names with hex values (similar to an assembler). If you are using a system with different base or register addresses, just substitute the correct hex value. If your system is a PC compatible, check your system Technical reference manual and make sure that the base address of the COM1 port is 03f8h.

The type declaration describes a record called regpack. When a variable is assigned the type regpack, it can be used in the Turbo Pascal interrupt procedure. This procedure allows access to the MS-DOS and ROM-BIOS interrupt vectors.

In order to keep the program as universal as possible, all access to system function calls (except window calls) are done through the MS-DOS interrupt 21. There are several minor exceptions. Procedure Setup programs the IBM-PC Async adaptor using ROM-BIOS interrupt 14. Procedures that use windows implement them using Turbo Pascal window procedures. References to Background and Text colors use Turbo Pascal procedures.

If your MS-DOS computer is not compatible with Interrupt 14, programming the Async board could be a problem. You can solve it by either setting up the board with a communications program before running COMM.COM, or finding out what the codes would be to set up your Async board and placing them in the Setup Procedure of the program. If your MS-DOS computer is not compatible with Turbo Pascal windows, you can delete any references to windows and the procedures that setup status windows for file transfers. If your MS-DOS computer is not compatible with Turbo Pascal color procedures, you can eliminate all of them. This is also possible for those who do not have a color display. If left in, there is no problem with running on a Mono display, but if for some reason memory is a problem, you can save a little on the text and code that is generated. These are all of the problems that I can see if you are using a more ''incompatible'' PC-compatible.

THE EMULATOR - KEY TO THE PROGRAM

I have been told that one of the reasons that programs like this are hard to write is because it is hard to make a computer act like a terminal. I feel this is partially true, because most programmers don't try to understand how the hardware in the terminal operates. If you sit down and block out exactly what goes on, you will see that it is really quite easy.

A terminal spends 99% of its time looking for an input. If it doesn't see one, it then checks to see if a key has been struck. If so, it transmits it. If the terminal receives a character (and it is a ''smart'' terminal), it checks to see if it has been sent a command (i.e. clear screen) from the computer system. If it has, it performs the function. If it hasn't, then it assumes the character received is to be displayed, and it does so.

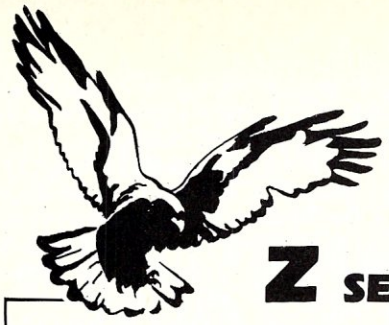
To implement this from software, especially from a high-level language is very tricky. You might try to write machine-code routines if you like, however, this program is able to do all direct I/O controls using conventional Turbo Pascal procedures.

The main program section begins with a menu. You select to use the program for either file transfers or as a terminal to run the slave computer system. Since we are looking at the Terminal emulator, we will select option #1.

Selecting option #1 puts you into the terminal emulator mode. The first thing the program does upon entering the emulator is send a control-C character over to the slave system. This serves two purposes. First, it performs a CP/M warm-boot. Second, if a program (such as the file transfer program XFER.COM)was running, it stops that program and returns the slave to the CP/M command mode. From that point on, the program simply uses two procedures, receive and transmit, to control the slave system. Procedure RECEIVE simply calls another procedure named IMSAI. IMSAI is a look-once routine that scans the Async Modem control register to see if the slave is on-line, and if so, scans the Line Control Register to see if a character has been received. If a character was ready, IMSAI performs two important routines. First, it drops the RTS line which prevents the slave computer from transmitting any more data until the Master is ready. This little trick allows the program to operate without the need for a communications buffer area in the Master Computer system's memory. Secondly, procedure IMSAI reads the Async adaptor's base port and gets the data that was transmitted. If a character was received, IMSAI sets RXRDY true.

When the program returns to procedure RECEIVE and RXRDY is true, it checks to see if the code that was received was a lead-in code for the implementation of the Hazeltine 1500 remote commands. CONTROLCODE, which is a local procedure to Receive, is the only hardware dependent module in the program. If, for example, you wish to emulate another type of terminal, then substitute its lead-in code and change the values scanned in procedure CONTROLCODE to make your emulator work. Before RECEIVE returns to the main program, it repeats to make sure no other characters are ready to be received. When the slave has finished transmitting, the program then branches to see if a key was struck on the Master computer.

Procedure IBMKEY detects if a key was struck by using MS-DOS function call #6. This is necessary because it is the only character input routine for the PC that does not detect a control-break



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(control-c) code. This makes it possible to transmit the control-C (warmboot for CP/M) to the slave computer without halting the Master computer's program. Function call #6 will return with a zero in register AL if no key was struck or with the character in register AL that was entered on the Master keyboard. If a character was detected, TXRDY is set true.

If TXRDY is true, the main program now checks to see if the user desires to break the link between the computers. This is necessary because control-C is masked out to allow it to warmboot the slave. Therefore some kind of control codes are needed to stop the program when it is running in the emulator loop. I picked control-u then control-f as my break code. Again, the selection is entirely up to you. If a control-u was pressed on the keyboard, the program checks if the next code is a control-f. If so, the program returns to the Main menu. However, if any other key has been pressed, the program calls procedure SEND. Procedure SEND checks to see that the slave is online. It checks for a DSR signal, and if valid, sends the character to the slave computer.

Before leaving the emulator, I would like to explain why there are two variables, BUFFER and IBMDATA, declared for the character handling routines. BUFFER is declared as a byte. IBMDATA is declared as a character with the same address as BUFFER. This was done in order to allow the program to sometimes treat the variable as an eight bit value and at others as an ASCII character. If you write programs that need to do special things like the emulator, you might want to try this to allow you some programming flexibility.

FILE EXCHANGE - MASTER TO SLAVE COMPUTER

There are several ways (file capture,memory buffering, etc)to do one-way transfers from the S-100 system to the PC. However, two-way traffic requires both systems to create and save files and signal the other when they are done.

The easiest way I found was to write another program for the IMSAI called XFER.COM. This program would be loaded by the PC file transfer sections and remain resident until the Terminal Emulator section of the program was given control. The basic function of XFER.COM would be to see which way the PC was requesting file transfer. If it was going from the IMSAI to the PC, the IMSAI would find the file, flag the PC that its ready to send and wait for the PC to give permission to transmit. If file transfers were from the PC, the IMSAI would create a file of the correct name and signal the PC to transfer, and signal the PC when it had finished.

The PC is also required to do the same functions. These, however, are incorporated inside of COMM.COM and do not need to be loaded externally.

When you enter the IMSAI-to-PC loop, the program opens two windows. One reflects what is going on with the PC, the other displays what is going on in the S-100 system. The program queries you for a file name and allows one-disk user to put another disk in at file-transfer time. From here on out, the two computers handle all file transfer procedures.

Using procedure LOADISP, the PC commands the IMSAI to load the XFER.COM program. When this is loaded, the IMSAI transmits the ASCII character '#' back. If a '?' is received, it indicates the CP/M system could not find the file, and the program is aborted.

When XFER.COM is loaded, the PC sends a "R" to the IMSAI, instructing it that the file transfer will be a IMSAI system "read" of the terminal. Again the IMSAI signals its ready with the "#" symbol. At this point, if the user had indicated that the program was on another disk, the procedure allows you to change disks on the S-100 system. When you have done so, or if the program was on the same disk as XFER.COM, the actual file transfer begins.

The PC sends the filename to the IMSAI. The IMSAI creates a file and if successful, signals back with an "@" symbol. If there was a problem in creating the file, the IMSAI will send a "!" symbol, which halts the process and return to the main menu.

Next, the PC opens the desired file and transfers the file until a Control-Z (hex 1A) is read, indicating end-of-the PC file. When detected, the PC sends a Control-Z to the IMSAI, which upon reception, closes the file and returns to the XFER.COM menu loop. XFER.COM stays resident until the emulator portion of the program is re-entered.

FILE EXCHANGE - SLAVE TO MASTER

In a similar manner as above, the PC program asks for the name of the file to be transferred from the S-100 system. The PC commands XFER.COM to be loaded (if not already resident in the IMSAI), sends a "W" telling the IMSAI that it will write the file to the terminal (PC), and sends the name of the file to transfer. When located, the S-100 system sends a "@" symbol saying its ready to transfer. The PC now creates a file with the desired filename on the PC default drive and signals the IMSAI to start. When the IMSAI sees an end-of-file condition, it sends the PC a Control-Z character. Upon reception, the PC closes the file and returns to the main menu. The IMSAI returns to XFER.COM menu and remains resident.

For those only interested in one-way transfers, I wrote another option of transferring files using the CP/M "TYPE" command. Using this allows transfers without writing or loading XFER.COM on the S-100 system. No handshaking (except terminal hardware control) occurs between the two systems. The PC simply creates a file with the correct name on the PC default disk, commands the S-100 system to "TYPE" the file, and then captures into the file all characters transmitted by the IMSAI up to the CCP "A>" prompt.

THE FUTURE OF THE INTERSYSTEM PROCESSOR

I mentioned at the beginning of this article that this could open up new horizons for you. With a terminal emulator and file transfer framework installed, you could now begin to write multi-system processing jobs, spool-printers, remote acquisition of data via the S-100 system, and many other tasks that are left to your imagination. You could make the whole program interrupt driven instead of software polled, or make certain multi-system tasks use interrupts to the MS-DOS PC that you are using. I used the S-100 to spool-print this article while I worked on a spreadsheet on the PC. I hope that you give it a try. You will find it well worth your time !

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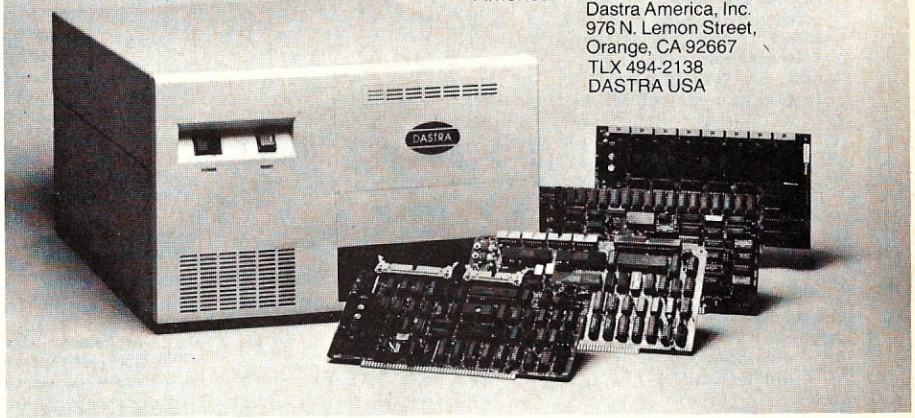

Hank Volpe has been hooked on computers since the mid '70's when he built his IMSAI S-100 system from a kit. This system now has 56k of RAM (24k built and etched by hand), a Ithaca Intersystems Z-80 card, and a North Star MDS SSDD disk controller. Languages include Turbo Pascal, Fortran, Pilot, North Star Basic, and Microsoft Macro-assembler. The IBM-PC supports a Mono & Color monitor, 256K ram,an Async Adaptor, and its languages are Basic, Turbo Pascal, LOGO, and a Microsoft Macro-assembler. He is Assistant Chief Engineer for WKBW-TV, where he uses computers in a wide variety of tasks from Character Generators and Graphic "Paint-Boxes" to controlling an Automated Satellite TVRO system. Readers with questions about hardware and control systems, color TV, graphic displays, or almost anything electronic, can write to him at WKBW-TV, 7 Broadcast Plaza, Buffalo NY 14202.

```
program Comm;
{$V-,K-}

{Program emulates a Hazeltine 1500 terminal and supports 2 way file}
{transfers between the PC and a Serially-interfaced Computer}
{ Host Computer   IBM-PC 256K ram}
{ Target Computer IMSAI 8080 56K ram}

{Program written By Hank Volpe (c) 1985}
{Program is released to Public Domain use}


label 1,2,3,4,selection,loop,menu;

const
 {The following addresses are Serial-Interface Dependent}
 {They are based on the Port address of the IBM-PC of COM1}

       base  : integer = $03f8; {base  port address}
    control  : integer = $03fc; {modem control register port}
    linestat : integer = $03fd; {line status register}
   modemstat : integer =  $03fe; { modem status register}
     rts_dtr : byte = 3;    {dtr,rts on IBM-PC set on by this command}
        dsr  : byte = $20;  {dsr mask for Modem status register}
         dr  : byte = 1;    {DR indicates character received by PC}
    imsai_rdy: byte = $30;  {Mask to see if IMSAI has DSR & CTS lines on}
      hold   : byte = 1;    {turns off rts command & keeps up dtr}

type
{this type is used by MS-DOS function calls}
   regpack = record
         ax,bx,cx,dx,si,di,es,cs,ds,flags : integer;
  end;
  scr_buf  = string[80];

var
  x,y,z   : integer;
  buffer  : byte;
  ibmdata : char absolute buffer;
  previous: char;
  txrdy   : boolean;
  rxrdy   : boolean;
  change  : boolean;
  transfer: boolean;
  offline : boolean;
  xpos,ypos : byte;
     line : byte;
    modem : byte;
  recpack : regpack;
  screen  : scr_buf;
  answer  : char;
  filename: string[14];
  disk    : file of byte;
  loadstring : string[25];

{These window procedures can be deleted if your MS-DOS system does not}
{support IBM window function calls. If you delete them, make sure all}
{calls for these procedures are also deleted in the source code}

procedure clrwindow;
begin
     window(1,1,80,25);
end;

procedure mainwindow;
begin
     clrwindow;
     window(1,1,80,24);
end;

procedure ibmbanner;
begin
     window(1,6,80,14);
end;

procedure imsaibanner;
begin
     window(1,14,80,23);
end;

procedure ibmwindow;
begin
     window(1,7,80,13);
end;

procedure imsaiwindow;
begin
     window(1,15,80,23);
end;

procedure center (holder : scr_buf; ypos : integer);
{This procedure centers a string on the screen}
var
   xpos  : integer;

begin
     xpos:=(80-length(holder)) div 2;
     gotoxy(xpos,ypos);
     write(holder);
end; {center}

procedure setup;
{procedure programs pc modem for 9600 baud,1 start, 1 stop no parity}
begin
   with recpack do
    begin
       ax:=$00e7;{sets Async Port to 9600 baud, 1 start 8 bits 1 stop bit}
       dx:=$0000;
      end;
      intr($14,recpack);
end; {setup}

procedure oncom;  {used to print an on-line communications row}
begin
    clrwindow;  {clear all windows}
    window(1,25,80,25);
    gotoxy(1,25);
    textbackground(green);textcolor(white);
    clreol;
     if transfer = false then
    write('ON LINE....CNTL-C IS CP/M BOOT  CNTRL-U/CNTR-F IS IBM BREAK ')
    else
    write('ON LINE...       Xfer.com Resident in IMSAI memory');

end;  {oncom}

procedure online;
{procedure determines if DSR & CTS are set indicating IMSAI is ready}
{To receive data..Program loops till IMSAI is ready}

begin
  if offline in [true] then
   begin
     window(1,25,80,25); gotoxy(1,25);textbackground(red);
     write('Slave System is not on line.... Check Slave status');
   end;

 while offline in [true] do
  begin
       port[control]:=rts_dtr;
       modem:=port[modemstat];
       modem:=modem and dsr;
       textbackground(red);
       clreol;
       if modem <> dsr then offline := true else offline :=false;

        setup;
   end;
     begin
          oncom;
          mainwindow;textbackground(black);lowvideo;clrscr;
          gotoxy(1,1);
      end;
end; {online}

procedure ibmkey;
{procedure detects if key was struck on PC Console using direct i/o}
{This is necessary in order to use control-c for the cp/m system}
{txrdy returns false if no key was struck. Buffer returns with character}
{code typed if key was struck and txrdy returns true}

begin
     txrdy:=false;
     with recpack do
      begin
           ax:=$0600;
           dx:=$00ff;
      end;
      msdos(recpack);
      recpack.ax:=recpack.ax and $00ff;

    if recpack.ax <>0 then
     begin
        recpack.ax:=recpack.ax and $00ff;
        buffer:=recpack.ax;
        txrdy:=true;
    end;

end; {ibmkey}
```

```
procedure imsai;
{this is a look only once routine}
{get character from imsai 8251 usart and flag caller loop if ready}
{If not ready, rxrdy returns false}

begin
     rxrdy:=false;

     port[control]:=rts_dtr;{Tell IMSAI to send a character}
     modem:=port[modemstat];
     modem:=modem and dsr;

    if modem = dsr then
     begin
          port[control]:=hold; {inhibits IMSAI from tranmitting any more}
          line:=port[linestat]; {till this character is processed}
          line:=line and dr;
             if line = dr then
             begin
                  buffer:=port[base];
                  rxrdy:=true;
             end;
     end;
end; {imsai}


procedure getchar;
{routine loops waiting until IMSAI is ready to transmit a character}

begin
     rxrdy:=false;
     while rxrdy=false do
       begin
            imsai;
       end;
end; {getchar}


procedure receive;
{procedure contains only terminal dependent data in system}
{Control codes for Hazeltine 1500 terminal are implemented in }
{routine Controlcode which is called only if character was transmitted}
{by IMSAI that was >=125 (126 is leadin code for control routines}

procedure controlcode; {local procedure for receive only}
{process hazeltine 1500 screen codes}
 begin
      getchar;
      {first see if it is a cursor position routine}
      if buffer = 17 then
       begin
           getchar;
           xpos:=buffer;
           if xpos < 1 then xpos:=1;
              getchar;
              ypos:=buffer; ypos:=ypos+1;
              gotoxy(xpos,ypos);
        end
        else { if not,check for other control conditions}
         begin
              case buffer of
              28: clrscr;
              31: textcolor(yellow);
              25: lowvideo;
              15: clreol;

              12: begin
                     xpos:=wherex ; ypos:=(wherey)-1;
                     gotoxy(xpos,ypos);
                  end;

              11:  begin
                      xpos:=wherex; ypos:=(wherey+1);
                      gotoxy(xpos,ypos);
                   end;
              16:  begin
                      xpos:=(wherex+1); ypos:=wherey;
                      gotoxy(xpos,ypos);
                   end;
              end;
          end;
     end; {controlcode local procedure}


begin {receive}
 repeat
     imsai;
       if rxrdy=true then
          begin
              if (buffer >125) then  controlcode
              else
               write(char(buffer));
           end;

   until rxrdy in [false];
end; {receive}


procedure send;
{procedure takes character and sends it to IMSAI}

begin

     port[control]:=hold;
     modem:=port[modemstat];
     modem:=modem and imsai_rdy;

     if modem = imsai_rdy then
      begin
          port[control]:=hold;
          line:=port[linestat];
          line:=line and dsr;
          if line = dsr then port[base]:= buffer;
      end;

end; {send}


procedure loadisp;
{procedure loads and communicates with isp module on imsai}
begin

  loadstring:=loadstring+char(13);

  imsai;
    if rxrdy in [true] then receive;
  for x:=1 to length(loadstring) do
   begin
        ibmdata:=loadstring[x];
        send; delay(10); { delay so UART can turn around line}
        receive;
   end;
end; {loadisp}


{Main program loop starts here}
begin
     clrscr;
     transfer:=false;
     offline:=true;
     setup;
     online;
     buffer:=$07;

menu:
     mainwindow;
     textbackground(black);
     clrscr;
     online;
     textcolor(lightblue);
     screen:='I N T E R S Y S T E M   P R O C E S S O R   P R O G R A M';
     center(screen,1);
     screen:='Version 1.1 ..from Hank Volpe Computers (c) 1985';
     lowvideo;
     center(screen,2);
     screen:='Select from the following menu';
     center(screen,7);
     gotoxy(20,9);
     write(' 1) Emulate Hazeltine 1500 Terminal');
     gotoxy(20,11);
     write(' 2) Transfer ASCII files from IMSAI to IBM-PC');
     gotoxy(20,13);
     write(' 3) Transfer ASCII files from IBM-PC to IMSAI');
     gotoxy(20,15);
     write(' 4) Transfer CP/M files to the IBM-PC via TYPE Command');
     gotoxy(20,17);
     write(' 5) End Program Loop');

selection:
     gotoxy(1,19); clreol;
     write('Enter Selection : ');
     read(answer);
      case answer of
       '1': begin
                clrscr;
                goto 1;
            end;
```

```
        '2': goto 2;
        '3': goto 3;
        '4': goto 4;
        '5': halt;
        end;
    goto selection;


{Main program loop for Hazeltine 1500 emulation}
1:
    buffer:=$03; send;
    delay(10);
    receive;
    transfer:=false;
    online;

loop:
  receive;
  ibmkey;
   if txrdy = true then
    begin
      if ibmdata=char(21) then
{procedure breaks link between computers but does not stop}
{any processing being done by slave unit}
{break codes can be modified to any desired by user}
 begin
     repeat
         ibmkey;
        until txrdy=true;

       if ibmdata = char(6) then
        begin
           clreol;
            xpos:=wherex; ypos:=wherey;
            window(1,25,80,25);
            gotoxy(1,25);
            textbackground(red); textcolor(yellow);
            clreol;
            write('Break code received...Do you wish to break link ? : ');

            read(ibmdata);
            ibmdata:=upcase(ibmdata);
              if ibmdata = 'Y' then goto menu else
                 begin
                    oncom;
                    mainwindow; textbackground(black);
                    lowvideo;
                    gotoxy(xpos,ypos);
                 end;
        end;
       end

      else
      send;
   end;
  goto loop;


{routine transfers files from IMSAI to PC.  IMSAI must have}
{disk containing INTERSYSTEM software in default drive. If disk}
{change is necessary, program will prompt user when necessary}

{When Xfer.com program is loaded on IMSAI, it will signal}
{PC with an "#".  PC will send filename to IMSAI
{If file is found, IMSAI will transmit "@" }
{indicating it is ready to send file data. When finished, IMSAI will}
{transmit  1AH (Cntl-Z) saying file has been transferred}

2:
  clrscr;
  gotoxy(1,1); textcolor(yellow);
  writeln('INTERSYSTEM XFER PROGRAM');
  writeln('IMSAI to IBM-PC');
  writeln('Version 1.0');
  writeln('Hank Volpe Computers (c) 1985');
  lowvideo;


{set up the display windows}

 ibmbanner; textbackground(red);
  clrscr; textcolor(yellow);
  textbackground(red);
  writeln('MMMMMMMMMM I B M - P C   F I L E   S T A T U S MMMMMMMMM');
  ibmwindow;
  gotoxy(1,1);
  write('Enter the name of the file : ');
  readln(filename);
  writeln;
  write('Is this file on another disk ? : '); readln (answer);
  answer:=upcase(answer);
   if answer = 'Y' then change:=true else change:=false;

  imsaibanner;
  gotoxy(1,1);
  writeln('MMMMMMMMMM I M S A I   F I L E   S T A T U S MMMMMMMMMMM');

 ibmwindow; clrscr;
 {load imsai isp}
 loadstring:='xfer';
 loadisp;


{PC now waits for '#' to indicate program is running or ? to indicate}
 { program was not found by CP/M}

 imsaiwindow;
 gotoxy(1,1);
 if transfer in [false] then
 begin
      writeln('Waiting for program to load');
        repeat
              imsai;
        until ibmdata in ['#','?'];

       if ibmdata = '?' then
         begin
             writeln('Program not found');
            goto  menu;
         end;
 end;

{Next, branch into File transfer program on IMSAI}
{If #, then program in loop, if > then back in CP/M}
  delay(10);
  transfer :=true;
  oncom;
  imsaiwindow;
  clrscr;

  loadstring:='W'; loadisp; {Send command to send file}
  repeat
        imsai;
        write(char(buffer));
  until ibmdata in ['#','>'];

   if ibmdata = '>' then
    begin
         writeln('Program loop terminated');
         goto menu;
    end;

  writeln;
   if change in [true] then
    begin
         x:=wherex ; y:=wherey;
         imsaiwindow;
         gotoxy(1,2);
         write('Change disk on IMSAI and press return to continue');
         readln(answer);
         imsaiwindow;
         gotoxy(x,y);
    end;


{Next send filename and wait for acknowledge (@) or no file (!)}
delay(10);
loadstring:=filename; loadisp;

delay(10);
repeat
      imsai;
until ibmdata in ['@','!'];


if ibmdata = '!' then
 begin
      writeln('File not found');
      goto menu;
 end;
writeln;

{Now Create file on PC and signal IMSAI when ready to transfer}
assign(disk,filename);
rewrite(disk);
writeln('Transferring file');
ibmwindow; clrscr;
gotoxy(1,1);
```

```
delay(10);
loadstring:='@'; loadisp; {send ibm ready}
delay(10);
 repeat
       getchar;
       write(ibmdata);
       write(disk,buffer);

 until buffer = $1a;
 close(disk);
 writeln('File Has been transferred');

repeat
      imsai;
      until rxrdy in [false];
      goto menu;

3:
{procedure transfers a file from IBM-PC to IMSAI in similar}
{manner as documented above.}

  clrscr;
  gotoxy(1,1); textcolor(yellow);
  writeln('INTERSYSTEM XFER PROGRAM');
  writeln('IBM-PC to IMSAI');
  writeln('Version 1.0');
  writeln('Hank Volpe Computers (c) 1985');
  lowvideo;


{set up the display windows}

 ibmbanner; textbackground(black);
  clrscr; textcolor(yellow);
  writeln('MMMMMMMMMM I B M - P C  F I L E  S T A T U S MMMMMMMMMMMM');

  imsaibanner;
  gotoxy(1,1);
  writeln('MMMMMMMMMM I M S A I  F I L E  S T A T U S MMMMMMMMMMMM');
  imsaiwindow; textbackground(red); clrscr;
  gotoxy(1,1);
  write('Enter the name of the file : ');
  readln(filename);
  writeln;

{load imsai isp}
ibmwindow;
clrscr;
loadstring:='xfer';
loadisp;
imsaiwindow;
clrscr;

{ PC now waits for '#' to indicate program is running or ? to indicate}
 { program was not found by CP/M}

if transfer in [false] then
begin
     writeln('Waiting for program to load');
       repeat
            imsai;
       until ibmdata in ['#','?'];

      if ibmdata = '?' then
        begin
            writeln('Program not found');
           goto  menu;
       end;
end;

{Next, branch into File transfer program on IMSAI}
{If #, then program in loop, if > then back in CP/M}
  delay(10);
  transfer :=true;
  oncom;
  imsaiwindow;
  clrscr;

  loadstring:='R'; loadisp; {Send command to send file}
  repeat
       imsai;
       write(char(buffer));
  until ibmdata in ['#','>'];

   if ibmdata = '>' then
    begin
         writeln('Program loop terminated');
         goto menu;
    end;

   writeln;


{Next send filename and wait for acknowledge (@) or no file (!)}
delay(10);
loadstring:=filename; loadisp;

delay(10);
repeat
      imsai;
until ibmdata in ['@','!'];


if ibmdata = '!' then
 begin
      writeln('ERROR');
      goto menu;
 end;
writeln;

{Now Create the file on the IMSAI }
assign(disk,filename);
{$I-}
reset(disk); {$I+}
 if ioresult <> 0 then
   begin
        writeln('File does not exist on PC Default drive');
        delay(50);
        goto menu;
   end;

ibmwindow; clrscr;
writeln('Transferring file');
imsaiwindow; clrscr;
gotoxy(1,1);


delay(10);
  while eof(disk) in [false] do
   begin
        read(disk,buffer);
        send;
        getchar;
        write(ibmdata);
   end;

   buffer:=$1a;
   send;
   delay(10);
   imsai;

close(disk);
writeln('File Has been transferred');

repeat
      imsai;
      until rxrdy in [false];
      goto menu;


{ routine transfers files from IMSAI to PC using type cp/m}
{command. This frees user from having to have Xfer.com present on}
{S-100 system computer. This is for one-way transfers only !!!}

4:
  clrscr;
  gotoxy(1,1); textcolor(yellow);
  writeln('INTERSYSTEM XFER PROGRAM');
  writeln('IMSAI to IBM-PC');
  writeln('Version 1.0');
  writeln('Hank Volpe Computers (c) 1985');
  lowvideo;


{set up the display windows}


 ibmbanner; textbackground(red);
  clrscr; textcolor(yellow);
  textbackground(red);
  writeln('MMMMMMMMMM I B M - P C  F I L E  S T A T U S MMMMMMMMMM');
  ibmwindow;
  gotoxy(1,1);
  write('Enter the name of the file : ');
  readln(filename);
  writeln;
  imsaibanner;
  gotoxy(1,1);
```

```
  writeln('MMMMMMMMMM I M S A I   F I L E  S T A T U S  MMMMMMMMMM');

ibmwindow; clrscr;
{load imsai isp}
loadstring:='type '+filename;
loadisp;


{PC now waits for '#' to indicate program is running or  ? to indicate}
 {program was not found by CP/M}

imsaiwindow;
gotoxy(1,1);

{Now Create file on PC and signal IMSAI when ready to transfer}
assign(disk,filename);
rewrite(disk);textbackground(green);clrscr;
writeln('Transferring file');
ibmwindow;textbackground(green);clrscr;
gotoxy(1,1);

delay(10);
 repeat
       getchar;
       loadstring:=previous+ibmdata;
       write(ibmdata);
       write(disk,buffer);
       previous:=ibmdata;

 until loadstring = 'A>';
 close(disk);
 writeln('File Has been transferred');

repeat
      imsai;
      until rxrdy in [false];
      goto menu;

 end.
```


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```
************************** LISTING 2 ******************************

program intersystem_processor;
{program must be on default drive of S-100 system when}
{Master MS-DOS computer enters file transfer mode}

{allows 2 way transfer of ASCII files between systems}
{Program written by Hank Volpe Computers (c) 1985 and released to}
{Public domain use}

label 1;

var
   x,y,z   : integer;
   disk    : text;
   buffer  : char;
   ibmbyte : byte absolute buffer;
   command : char;
   more    : boolean;
   answer  : char;
   filename: string[12];

procedure sendfile;
begin
     write('#'); {signal PC that sendfile is active}
     read(filename);
     bdos(13);
     {$I-} assign(disk,filename);
           reset(disk); {$I+}
       if ioresult <> 0 then
         begin
              write('!');
              halt;
         end;
      write('@');
      repeat
            read(command);
      until command = '@';
      delay(10);
      while eof(disk) in [false] do
       begin
            read(disk,buffer);
            write(buffer);
       end;
       close(disk);
       write(char($1a));
  end;

procedure getfile;
begin
     write('#'); {signal PC that sendfile is active}
     read(filename);
     bdos(13);
     {$I-} assign(disk,filename);
           rewrite(disk); {$I+}
       if ioresult <> 0 then
         begin
              write('!');
              halt;
         end;
      write('@');
      repeat
            read(kbd,buffer);
            write(buffer);
            write(disk,buffer);
      until ibmbyte = $1a;
       close(disk);

end; {getfile}

{Main menu starts here...note screen printing is not necessary except}
{when debugging in Emulator mode, however # prompt must be}
{printed if all other messages are not}

begin
     clrscr;
     writeln('INTERSYSTEM PROCESSOR');
     writeln('Version 1.0 Imsai/IBM-PC');
     writeln('Hank Volpe Computers (C) 1985');
     writeln; writeln;

1:
    write('Enter Command #'); {all above except write ('#') can be deleted}
     read(command); command :=upcase(command);
      case command of
       'W':sendfile;
       'R':getfile;
      end;
     goto 1;

end.
```

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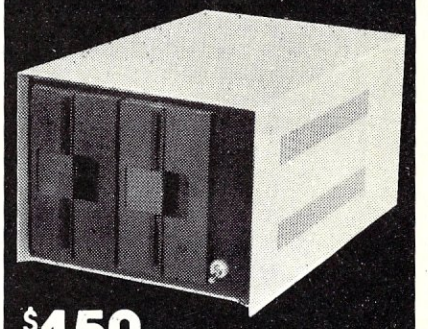

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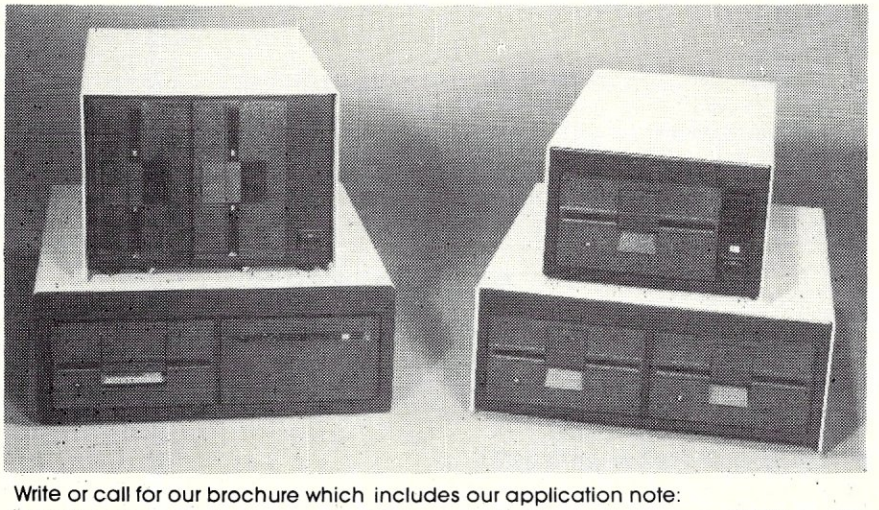

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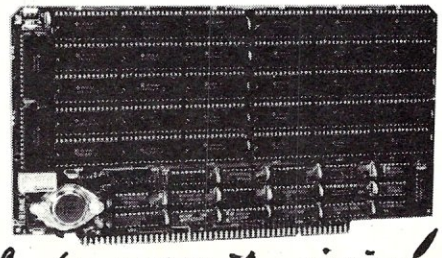

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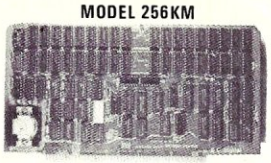
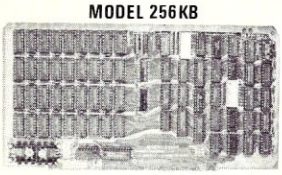


MODEL 256KB



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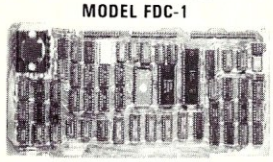

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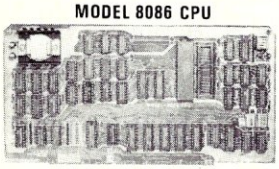

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The UNIX File

by Ian F. Darwin

This column discusses the UNIX operating system. If you have comments or questions about UNIX or this column, please write to Ian Darwin at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8. If you have access to the uucp network, mail "ihnp4!darwin!ian". I can't always answer immediately, but I will get back to you; electronic mail gets answered first!.

UNIX Public Domain Software & A hidden UNIX Gem

UNIX Public Domain Software

Finally - an archive of UNIX public-domain software. There are two main 'source' newsgroups on the UNIX network called USENET, namely *net.sources* and *mod.sources*. Net.sources is unmoderated, that is, anybody can post anything to it, and they do. Mod.sources is 'moderated', that is, it has a moderator who gets to approve or veto postings. There is a growing trend to use of moderated newsgroups on USENET as the number of sites coming online explodes and the number of ignorant postings continues to rise. Thus postings about your Aunt Petunia's gardening secrets might well appear in an inappropriate unmoderated group, but will be excluded from the moderated newsgroups. Being moderator is strictly a volunteer position, in keeping with USENET tradition. John Nelson moderates the USENET newsgroup *Mod.sources*, and in Volume 3, Issue 26, posted the index of what's available.

John has set up an archive of all the software posted to mod.sources. Unfortunately, archive access is *not* available automatically - he has to mail files out electronically. He is hoping to have multiple sites maintain and distribute the mod-.sources archive in the future. There is currently no mechanism for uucp access to the archive, such as allowing you to give a *uucp* command to get the programs without manual intervention by John. Some of the new archive sites may be able to provide this service. To retrieve one or more modules from the Archives, John writes,

> "send me *uucp* mail - I will *mail* the files back to you. If multiple modules are requested, then I usually ask for a 9 track tape along with a self-addressed stamped mailer, and a (list of what sources you want). I will put the sources onto the tape in 1600bpi *tar* format. I am willing to consider alternative methods.
>
> "Note that I sometimes get backlogged, but if you send mail to me, and don't get a reply in a reasonable time (say two weeks) then you can assume that either I never recieved your note, or my reply got eaten (mail by *uucp* does not feature guaranteed delivery). Also, if you expect a reply via uucp mail, *please* include a return address starting at some well known site - especially if you are on a local network that uses unusual addressing conventions. More than once I have not been able to reply (and the apparent source sitename was not in the uucp map)."

I think John understates the case. He is doing this strictly on a volunteer basis; if you don't get an answer immediately, please be patient. And if he directs you to another site closer to you, or requests that your site call his site directly, or asks you in return to provide a copy of the full archive to other local sites, please understand that John is doing this on his own and can only do so much. *Public domain software efforts must be supported by the public.* To get in touch with him, try one of these *uucp* addresses:{linus, decvax, mit-eddie}!genrad!panda!sources-request or seismo!harvard!wjh12!panda!sources-request.

If you have a program that you want distributed to mod.sources, send it to ...panda!sources; John will either pass it along to mod.sources, or suggest an alternative forum if there's a more appropriate newsgroup. Source programs should be of interest to the UNIX community; there are better distribution means for CP/M, DOS and other non-UNIX software - see the columns on SIG/M and PC/BLUE elsewhere in Micro/Systems Journal. To reach John by hardcopy mail, write to him (or send a tape with a return paid mailer and a list of what you want) to John P. Nelson, GenRad MS 6, 300 Baker Avenue, Concord, MA 01742, U.S.A. And thanks to John for undertaking this!

Access to the software archive in Australia is handled by Robert Elz (seismo-!munnari!kre); readers down under should contact him for details. In the future I'll try to list other sites that maintain full archives.

Table One lists the software currently available. Remember that it's public domain; although John Nelson has taken pains to reject obvious trash and copyright violations, it's the user's responsibility to determine the usefulness of the software. You'll see an interesting variety of coding styles, to say the least, and some obvious errors here and there. But if the program you want is listed, go for it.

Join - a mystery command

Join is one of those program that people are too rushed to read about, but not too rushed to reinvent. It's one of those tools whose idea sometimes seems easy to grasp only after you've already grasped it. But it is worth grasping. A "join" is a technical term in database circles for the operation of selecting all records that have the same field value in two or more tables or files. Say you have two files, one with name and salary and another with name and department, to wit

```
j.salaries:

Smith, John:$27,000
Smith, Mary:$30,000
Stone, V:$15,000

j.depts:

Smith, John:Physical Plant
Smith, Mary:Mental Plant
Stone, V:Plant Watering
Sz, Barth:Iconography
```

To start with a simple example, let's produce a file showing name, salary, and department. All you have to say is

```
$ join -t: j.salaries j.depts
Smith, John:$27,000:Physical Plant
Smith, Mary:$30,000:Mental Plant
Stone, V:$15,000:Plant Watering
```

The input files are stored with ':' delimiting the fields, so the output appears the same way; most any printable character could be used if it doesn't appear in the data. If the fields didn't have any spaces in them, you could use the default separator, which is white space (blanks and tabs).

What happened to Sz? Gone. By default, *join* only outputs the fields that match in both files. This is easy to change with the

'-a' flag - if you say

```
$ join -t: -a j.salaries j.depts
```

you get out

```
Smith, John:$27,000:Physical Plant
Smith, Mary:$30,000:Mental Plant
Stone, V:$15,000:Plant Watering
Sz, Barth:Iconography
```

This is slightly better, but still not right - Sz now has "Iconography" as the salary field. Let's try using more options - '-e' tells *join* what to print in place of empty fields. We'll try

```
join -t: -e xxx -a j.salaries j.depts
```

This probably should work, but doesn't, at least on my system. When I explicitly mention the fields I want printed (with the -o option), though, it works fine. The -o option takes a list of 'x.y' fields; each x is a file number (1 or 2), and each y is a field number within that file.

```
$ join -t: -o 2.1 1.2 2.2 -e xxx -a\
j.salaries j.depts
Smith, John:$27,000:Physical Plant
Smith, Mary:$30,000:Mental Plant
Stone, V:$15,000:Plant Watering
Sz, Barth:xxx:Iconography
```

Why did I use 2.1 for the first field, not 1.1? Try it and think about what you see.

If the files are organized with the join fields in other than the first column, you can specify alternate fields to be used with '-j'; the syntax is similar to that of '-o'.

Here's another example. This one modifies the normal who command to divide people on a machine into paying customers and others. Without *join*, we could simply get a list of who was paying, but this version includes all the normal information from *who*.

```
#! /bin/sh
# whop - who is paying to use the machine
F=/tmp/whopf$$
G=/tmp/whopg$$
H=/tmp/whoph$$
trap "rm -f $F $G $H; exit" 0 1 2 15

who >$F
cut -fl -d' ' $F >$H
egrep -f $H /etc/passwd | grep -v ',zz' |\
sed 's/:.*/ paying/' >$G
join $F $G
```

After some initialization, the first command puts the full *who* output into file $F. Then we use *cut* to get just the first field, i.e., the names of the users currently logged on, into file $H. Then we *egrep* these users from the password file, and from them exclude internal staff (on our system, all internal staff have 'zz' at the beginning of a field in the accounting entry in the password file), and put the word 'paying' at the end of each line. So file $G contains lines like

```
mary    paying
auser   paying
```

Then we simply join the *who* output with this file, and get a list of who is paying to use the machine. You can probably see how to modify this command (use '-a') to print everybody's information along with flagging the paying customers, and adapt it to your own system's localisms.

Despite its power, *join* remains underutilized in the UNIX community. Look at the */bin/lorder* shell file for another example. *Join* is not perfect. It is picky about options: -t can not take a space between the t and the character, while -o must have a space (presumably future versions of *join* will use the standard *getopt* argument parser). But it's a powerful tool for merging parallel files. Knowledge of its use belongs in every UNIX programmer's tool kit.

That's all for this month. I'd be glad to get letters and electronic mail on these topics. Suggestions for topics for future columns are always welcome. Cheers!

Table 1 - UNIX PUBLIC DOMAIN SOFTWARE (mod.sources archive)

Volume 1:

ANSI.C	(1 part)	Yacc & Lex for 11/12/84 draft ANSI C
ANSI.bug	(1 part)	Small bug in ANSI C Yacc grammar
Bourne	(9 parts)	Bourne shell enhancements (history, tilde, job control)
Smail	(1 part)	Smart net mailer - front end using pathalias data
UK-1.1	(3 parts)	UK-1.1 Sendmail Configuration Package
Xlispl.4	(4 parts)	Lisp in C with object oriented extensions
bed	(1 part)	Editor for binary files. Front end for ascii editors
cforth	(3 parts)	Forth Interpreter written in C
checkin	(1 part)	editor interface for RCS logs
compress 3.0	(1 part)	Compression program better than pack or compact
cpg+mdep	(1 part)	cpg-C formatter, mdep-make dependency generator
cpg+mdepX	(1 part)	cpg + mdep updates
cpp	(3 parts)	C preprocessor-for use with Decus C
cshar	(1 part)	shell archive builder (shar) in C
cshar2	(1 part)	C shar - improvements
cxref	(1 part)	C cross referencer
diffc	(1 part)	contextual diff (diff -c) -Bell systems
dynamic	(1 part)	dynamic loading code for 4.2bsd
getopt	(1 part)	public domain getopt(3)
lbgm	(1 part)	Newsgroup archiving - "lbgm"
newshar	(1 part)	The Connoisseur's Shar, version 2
newsweed	(1 part)	Newsweed: delete unwanted news articles
patch 1.3	(1 part)	Apply diff format output to update files
pcurses	(11 parts)	Public domain Terminfo/Curses (needs work)
rfc_882	(1 part)	RFC 882-Domain Names-Concepts & Facilities
rn 4.3	(9 parts)	rn news reading program version 4.3
rpc	(10 parts)	Sun "Remote Procedure Call" source code
sendmail.cf	(1 part)	GaTech Sendmail configuration
uucpanz.7	(1 part)	uucp status program: uucpanz (V7, BSD)
uucpanz.V	(1 part)	uucpanz for System V
uuque	(1 part)	uuwizard's utility-uucp queue snooping
vnews	(7 parts)	2.10.2 Vnews (news reader program)
vstr	(1 part)	dynamic string package
xfernews	(1 part)	uucp traffic batching system
xref	(1 part)	General purpose cross reference utility
vnews.1	(1 part)	Manual page for 2.10.2 vnews(1)
readnews.1	(1 part)	Manual page for 2.10.2 readnews(1)
expire.8	(1 part)	Manual page for 2.10.2 expire(8)

Mod.sources: Volume 2:

Smaill	(1 part)	update - smail (in volume 1)
access	(1 part)	Kernel Hacks for access control lists
basic	(4 parts)	BASIC interpreter in C (needs work)
bgrep	(1 part)	Boyer-Moore based fgrep like program
bm	(1 part)	much faster Boyer-Moore
bmX	(1 part)	various bm updates
choose	(1 part)	select lines at random
compress 4.0	(2 parts)	Compression-better than pack or compact
cshar3	(1 part)	update to C shar (in volume 1)
makekits	(1 part)	software "kit" generation script
mdump	(1 part)	multiple dump per tape utility
pathalias	(1 part)	New Release-mod.map database path optimiser
remote	(1 part)	Remote mag tape routines
remote2	(1 part)	small patch to remote tape library
rtar	(1 part)	Diffs to tar-use remote system's tape drive
runtime	(1 part)	runtime memory allocation for multi-dimensional arrays
tools	(6 parts)	Software Tools in Pascal
uroff	(1 part)	uroff - nroff underlining
uuhosts	(1 part)	uuhosts - automatically grab mod.map data for later use
wire	(2 parts)	Wirewrap program
wm	(4 parts)	BSD 4.2 window manager + Patches to Curses

Mod.sources: Volume 3: (so far)

Hey	(1 part)	Hey(1) [from Unix/World, Oct. 85]
LaserJet	(2 parts)	Ditroff HP LaserJet driver
bm 1.1	(1 part)	Ken Yap's changes to bm (in volume 2)
dtree 4.2	(1 part)	dtree (directory heirarchy display)- 4.2
idledaemon	(1 part)	Yet another idledaemon (BSD 4.2 only)
ieee	(6 parts)	IEEE Floating Point Calculator (Pascal)
laserjet	(1 part)	BSD 4.2+ lpd printcap/spooler for LaserJet printer
match	(1 part)	match - faster than bm (VAX only!)
mdump2	(1 part)	Revised mdump (multiple dump per tape utility)
modnotes	(1 part)	Notes (1.7 or later) updates - moderated groups
pretty	(1 part)	Pretty printer in lisp + MC-columnator in CLU
scpp	(2 parts)	Selective C preprocessor
times.awk	(1 part)	uucp info from LOGFILE (awk script)
ttyuse	(1 part)	Creates Summary of daily Terminal usage
uuhosts2	(1 part)	newer uuhosts (too many changes for diff listing)
uuhosts3	(1 part)	uuhosts update - extraction works properly again
GaTech	(3 parts)	sendmail patches/configuration files-Georgia Tech

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XL-DL88,8Mhz,512kb	*1050*
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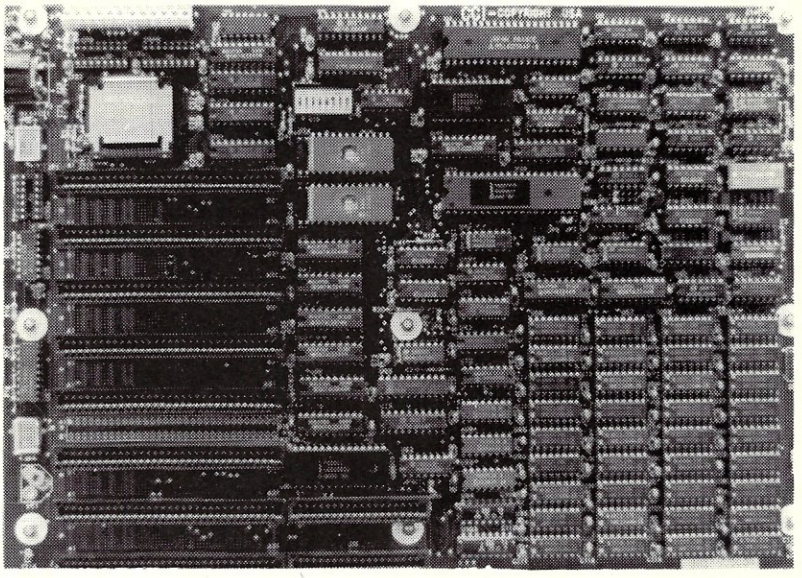

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The Data Base Forum

by Nelson T. Dinerstein

This column will be a regular feature in M/SJ. It will discuss problems associated with the application of database managers such as dBase-II/III, Framework, and Rbase 5000. Suggestions, comments and questions are welcomed.

dBase-II Speed Techniques - Part II

In Part I of this two-part series, I introduced rules for speeding up dBase-II applications. In this concluding part, I present five more rules and examples.

CHANGING RECORDS IN A FILE

In the following discussion, the term "a field upon which an index is based" will be used. If a file has a field named FIELDA and there is an index file, say A, that uses this field, then we say that index A is based upon the field, FIELDA. If a file is indexed on the field SSN (for social-security number) with the statement:

```
INDEX ON SSN TO SSNINDEX
```

then SSNINDEX is said to be based upon the field, SSN. If a file is indexed upon a combination of fields, then it is based upon each of the fields involved in the combination. For example, if a file is indexed upon the combination of LASTNAME and FIRSTNAME with the statement:

```
INDEX ON LASTNAME+FIRSTNAME TO NAMEINDEX
```

then NAMEINDEX is said to be based upon the field, LASTNAME and upon the field, FIRSTNAME. This terminology is introduced here because we will be interested in identifying fields in records that, when changed, affect the indices based upon these fields.

I recommend that you change records in an indexed file with a program that uses "@.. SAY .. GET" statements. This will allow you to display the current field values before you make changes, giving an extra measure of protection. Again, you will want to control the number of indices in use as carefully as possible. When you make any changes in an indexed file, dBase-II will update every index currently in use, whether or not you have made changes to a field upon which an index is based. In many cases, this is a terrible waste of time. I recommend that you use the following:

RULE 5: When changing the contents of a record in an indexed file, update only the indices that are affected by the changes.

Rule 5 can be applied in a variety of situations.

1. Displaying a record on the screen.

Never use the "@ .. SAY .. GET" statement for the records to be displayed in this type of program. Use only the "@ .. SAY" statement. This will insure that updating of index files will not take place when the user wishes only to view the data.

2. Changing only numeric fields.

Either remove (deactivate) the indices in use prior to the update or use a special program for the update. In the first case, we will need to verify, before the update of the data file, that no fields upon which indices are based have been changed. To do this, use the following technique:

(a) save the original record values in memory variables,

(b) capture the new record values in new memory variables,

(c) compare the new values with the old values,

(d) verify that there have been no changes to fields upon which indices are based, then

(e) update the actual record fields using the REPLACE statement.

In the second case, merely write a special program for the update. For example, in an inventory system, one frequently wishes to update the numeric fields, QUANTITY ON HAND, REORDER POINT, and REORDER AMOUNT. A special program to accomplish this will be the fastest and easiest since:

(a) at most one index is needed to FIND the appropriate record, and this index is easily removed (deactivated) prior to the actual update, and

(b) you will not need to verify whether changes have been made to fields upon which indices are based, because this type of program does not allow changes to such fields.

3. Changing one or more fields upon which indices are based.

I recommend that you use the following technique, if you have to change fields upon which indices are based:

(a) identify all of the indices affected by the changes,

(b) save the current record number,

(c) activate only the indices affected by the changes,

(d) GOTO the record whose number you have saved in step (b), then

(e) update the appropriate fields using the REPLACE statement.

The reason for saving the record number and then using the GOTO is as follows. Whenever you use the SET INDEX statement, either to establish (activate) new indices or to remove (deactivate) existing indices, the pointer to the current record of the file is lost. The value of # is now 0. To get back to the desired record, we use the GOTO. Example 4 illustrates this point:

Example 4.

```
USE X
ERASE
STORE "     " TO MEMKEY
@ 5,1 SAY "ENTER THE KEY" GET MEMKEY
READ
SET INDEX TO A
FIND &MEMKEY
IF # = 0
     @ 7,1 SAY "NO RECORD FOR KEY="+MEMKEY
     @ 9,1 SAY "TYPE ANY KEY TO CONTINUE"
     WAIT
     RETURN
ENDIF
STORE # TO MEMRECNO
* GET THE CHANGES HERE
* DETERMINE WHICH INDEXES TO USE
SET INDEX TO .....
GOTO MEMRECNO
* MAKE REPLACEMENTS AS NECESSARY
```

RULE 6: Never use the ".. SAY .. GET" statement for records when you wish only to view the contents of the record.

RULE 7: If you frequently change a group of or just one numeric record field(s), use a program for this task. Use an index to FIND the appropriate records, but remove (deactivate) the index before the actual update.

RULE 8: When REPLACING fields, make sure that only the required indices for that specific update are activated. The required indices may vary from record to record.

Be careful of the manner in which you use the REPLACE statement. *Each* REPLACE statement updates both the data file *and* all of the active index files. If you have N REPLACE statements in a row, it will take N times as long to update the files as one REPLACE statement will. It is therefore recommended that you substitute:

```
REPLACE A WITH MEMA, B WITH MEMB, C WITH MEMC
```

for

```
REPLACE A WITH MEMA
REPLACE B WITH MEMB
REPLACE C WITH MEMC
```

whenever it is reasonable to do so. But be careful, there is a limit on the length of any single statement allowed in dBASE II (254 characters). You absolutely must not exceed this limit. If you try to substitute one REPLACE statement for a group of them and you find that the statement exceeds the maximum allowable length, then you must use two or more statements.

RULE 9: Try not to have a group of REPLACE statements. If several REPLACE statements appear one right after the other, substitute with as few REPLACE statements as you can.

SEQUENTIALLY UPDATING NUMERIC FIELDS IN INDEXED FILES

There are occasions when you will need to access a data file sequentially through an index file and make changes in the data file. For example, in an inventory file you may wish to sort through the file in order by part number, changing specific values (Example 5). This is the case when you wish to update the QUANTITY ON HAND for a large percentage of inventory parts after performing a physical inventory count. We will use the appropriate index to sort through the file by part number, but we will remove the index before the update and will re-establish both the index and position within the index file after the update.

Example 5.

```
USE INVENTORY INDEX INVPARTNO
DO WHILE .NOT. EOF
     STORE # TO MEMRECNO
     SET INDEX TO
     GOTO MEMRECNO
     ERASE
     @ 5,1 SAY "ITEM NUMBER:" + INVPARTNO
     @ 6,1 SAY "QTY ON HAND" GET MEMQTY
     READ
     SET INDEX TO PARTNO
     GOTO MEMRECNO
     SKIP 1
ENDDO
```

Nelson Dinerstein is an Associate Professor of Computer Science at Utah State University and an active consultant in database applications on micros. He has a Ph.D. in mathematics from the University of Utah. And, he is the author of 8 books on dBase-II/III, Framework, and Rbase 5000 applications.

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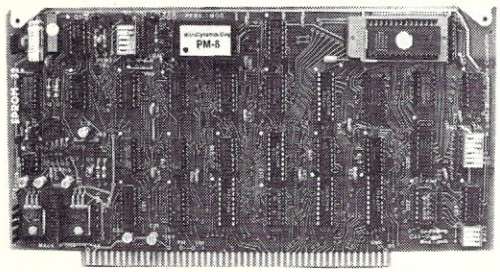

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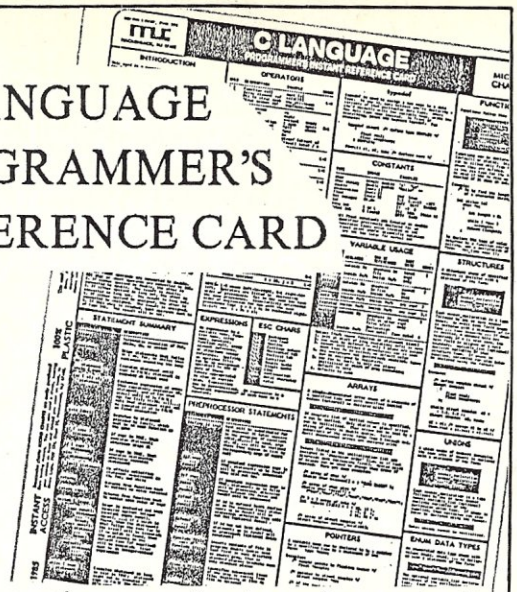

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                          END OF FILE
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```

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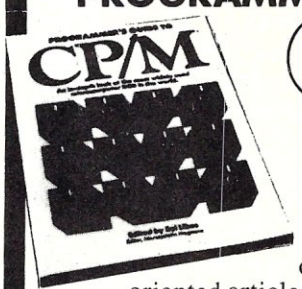

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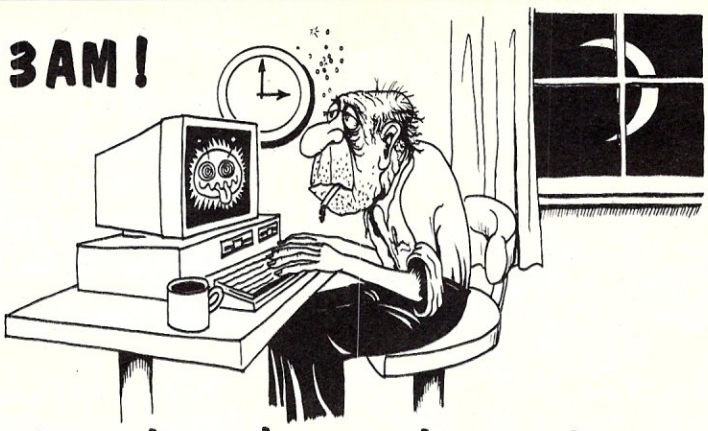

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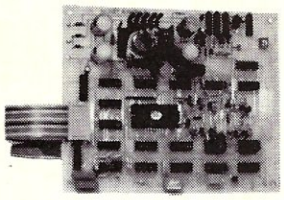

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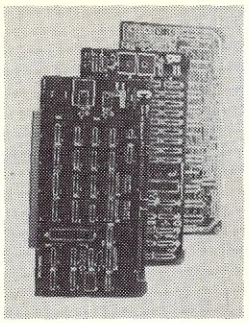

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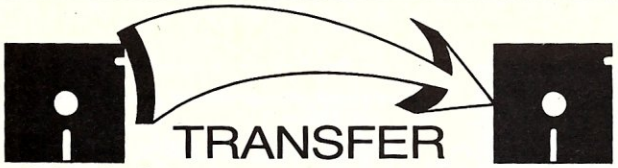

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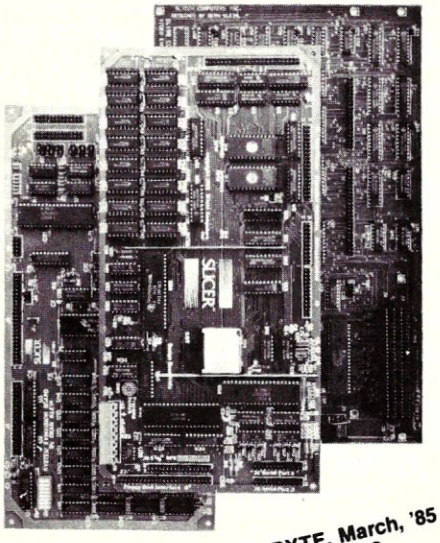

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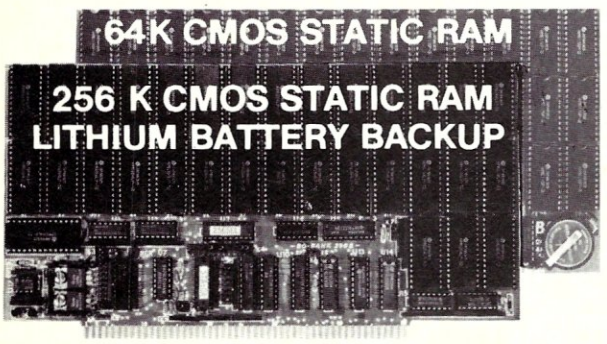

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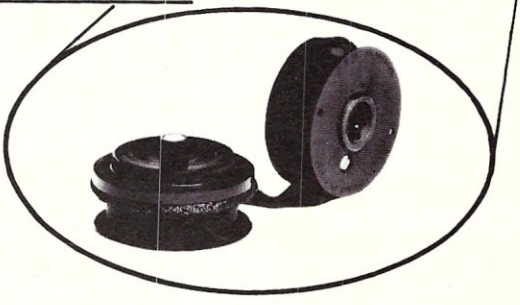

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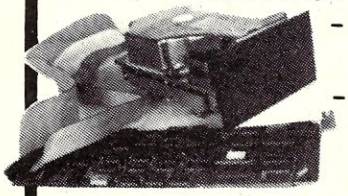

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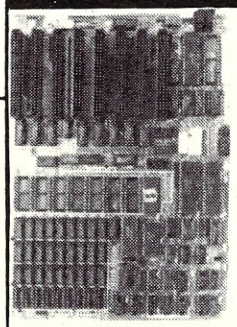

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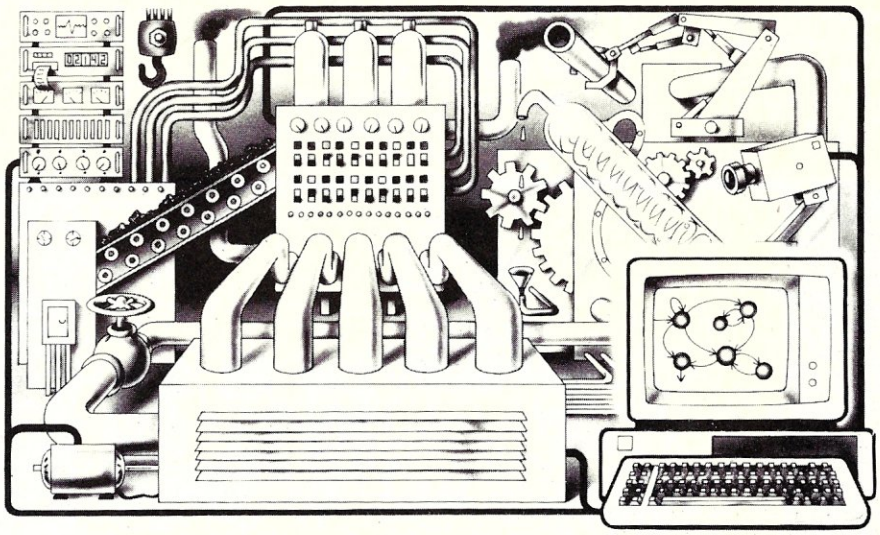

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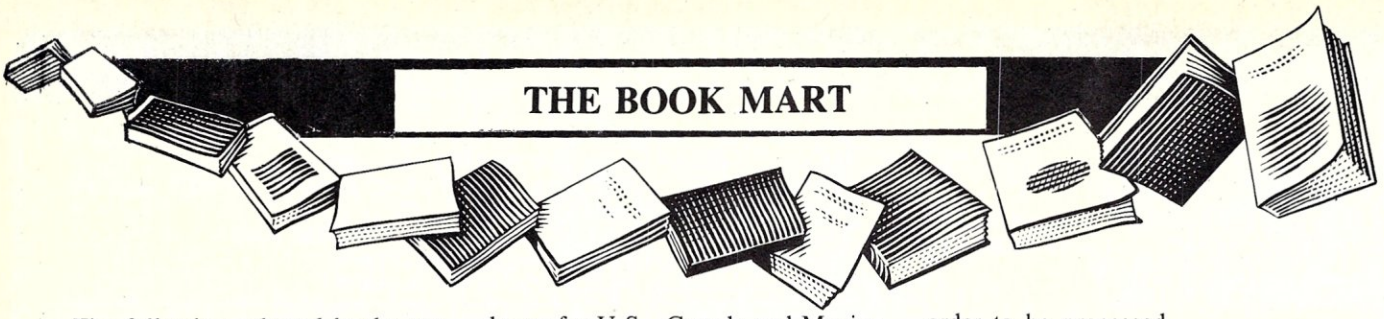

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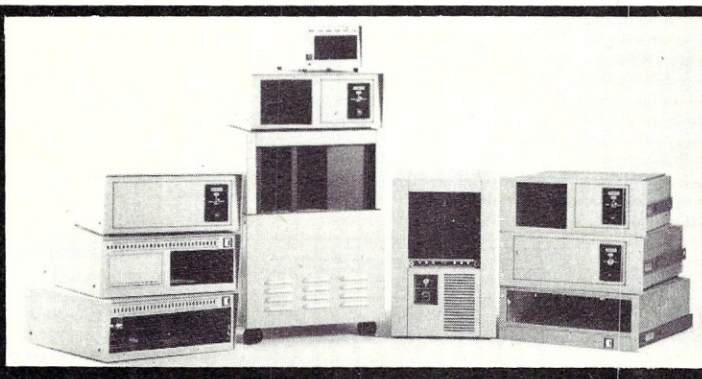

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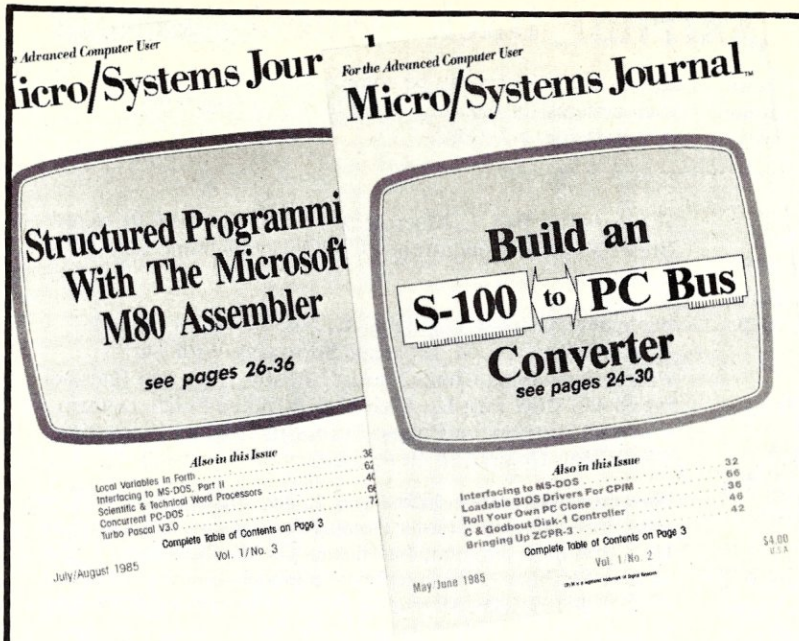

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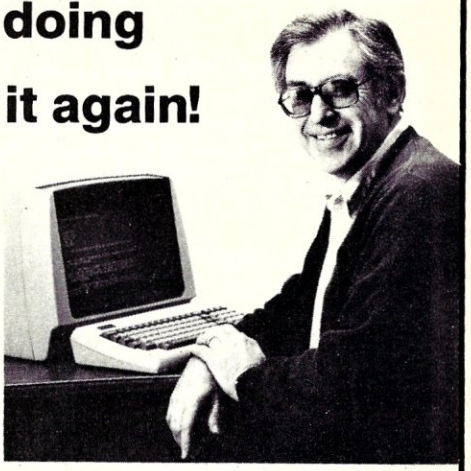

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MARCH/APRIL 1985 (Vol 1., No. 1): Bringing Up CP/M Plus, Assembly Language Extensions for MS-Basic, New Tricks for CP/M2.2, Building an IBM/PC or XT Clone, Extended Single Density Storage, Variable Size Arrays in C;REVIEWS: dBase-III and 16-Bit Lisp & ProLog-Part I.

MAY/JUNE 1985 (Vol 1., No. 2): Build an S-100 to PC-Bus Converter, Interfacing to MS-DOS Part-1, Loadable Drivers for CP/M2.2, Roll Your Own PC-Clone, Bringing Up ZCPR-3, C & Godbout Disk-1 Controller, Writing Translation Programs in C and Turbo Pascal; REVIEWS: 16-Bit Lisp & ProLog-Part II.

July/August 1985 (Vol 1., No. 3): Structured Programming With Microsoft M80 Assembler, Local Variables In Forth, Interfacing to MS-DOS Part-II, Data Translation with Turbo Pascal, Implementing Sets with Bit Operations in C, A Unix Mail List System; REVIEWS: Scientific & Technical Word Processors - Part I, Macrotech MI-286 S-100 CPU Card, Slicer System, Concurrent PC-DOS, Coherent Operating System.

September/October 1985 (Vol. 1., No. 4): Who Prints on Printer With CCP/M, Interrupt Borrowing With Turbo Pascal, Upgrading CompuPro I/O Boards, Program Interfacing to MS-DOS Part-III, SIG/M & PC/Blue Public Domain Software Distribution Points, TurboDos INSTALL program; REVIEWS: CompuPro 10+, TEX.

November/December 1985 (Vol. 1, No. 5): TurboCharge Your 8086/8088 Computer, Faster Floating Point Math with C, Bringing Up CP/M-68K, Program Interfacing To MS-DOS Part-IV, Advanced Machine Level Interface Techniques For Turbo Pascal, Context-Independent Macros for C, Build Your Own PC Program Library Using Public Domain Software, dBase-II Speed Techniques-Part I, Tuning Unix Program; REVIEWS: Peak 68K8-CP, Eureka For CP/M-80, Scientific Workstations.

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MARCH: MS-DOS Overview Part-I, Enhancing MP/M-II Part-2:adding login and date and time functions, Julian Date Conversions, I/O changes for Fortran-80, CP/M Mass Renaming by Filetype, C/PM BIOS public domain enhancements, Power Failure Backup for S-100 systems ; REVIEWS: MS-DOS for CompuPro From Computer House, Lomas Lightning One, Dual Systems SIO4, MagicBind, SAL/80K

JANUARY: Enhancing MP/M - Part 1; Installing MP/M; Add Concurrency to MP/M; Two Users on CP/M; Relocating Assemblers & Linkage Editors - Part 3; S-100 Wait States; REVIEWS: MP/M-8/16, ProComp-8, Paragraphics Game Board, ProLog.

1983

NOVEMBER: Intro to 80286, 68000, and 16032 Microprocessors; Intro to Local Area Networks - Part 2; Extended Memory Management for older S-100 Systems; Notes on Microsoft Fortran-80; Building S-100 Parallel Ports; REVIEWS: CompuPro CPU-68K, System 8/16, Xenith Z-100, Nevada & Ellis Computing Fortran.

OCTOBER: Intro to Local Area Networks, Part-1; Build Low-Cost LAN; Build S-100 Bubble Memory Card; Use Radio Shack Model 100 portable with a CP/M system; Write Menu-Driven Utility for Setting Printer Options; North Star Improvement; True Z-80 Random Number Function; Hide Code in Basic REM statements; Machine Code loader for MBasic; Increase Single-Density Disk Formatting; Relocating Assembler & Linkage Editors, Part-2; Run MX-80 with North Star; User Group Directory; CP/M-86 Versus CP/M-80; REVIEWS: CP/NET, QBAX, S-Basic.

AUGUST: XERA Program; Logging-On CP/M; WordStar Date/Time Patch; Find Location of Variable in NorthStar Basic; Prevent System Crashes During Warm Boot; Enhance Spreadsheet Print Files; Plotting Package-Part 3; Run WordStar under TP/M; 50-line Text Formatter; Using the LU Utility; User Areas under CP/M; REVIEWS: Stiff Upper Lisp, MuLisp-80, Supersoft Lisp, Cromenco C-10, Access Manager, Fancy Font, Computime SBC-880 S-100 card.

JULY: Using RCPMs; RCPM Directory; PIP Data Between Computers; Toward Smarter Modem Programs; Interface MX-80 via Parallel Interface; Digital Audio On CP/M System; Customize CP/M CBIOS; Plotting Package Part-2; REVIEWS: DRI PL/I-86 and PL/I-80, S-100 PMMI MM-VT1.

JUNE: Plotting Package Part 1; Drive HP Plotter; Laboratory Graphics Applications; Console Keypressed interrupts; Cutomize Wordprocessor Keyboard; WordStar Patch hor H-19/Z-19 Terminal; Relocatable Code; REVIEWS: Graftalk, JES S-100 Graphics Controller, ZCPR2.

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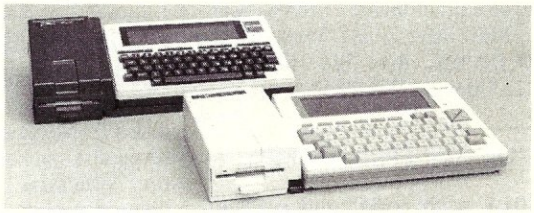

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APRIL: IEEE-488 Tutorial; Interfacing to Lab Instruments; CP/M-86 System in Lab; Implementing CP/M+ Part II; Build Simple S-100 Card Extractor; Macros & MacroAssemblers; REVIEWS: Pickles & Trout S-100 488 Controller; CP/M Utilites; Morrow Decision I.

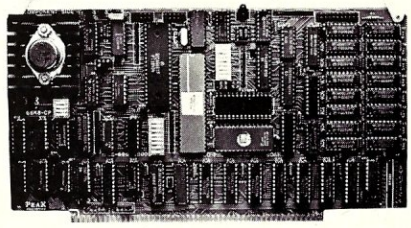
1982

NOVEMBER/DECEMBER: CP/M Vs MS/DOS; CP/M-86 Vs MS-DOS; Intro to ADA Part 2; Virtual Disk for NorthStar; CP/M Program Auto-execute; Macros & Macro-Assemblers; REVIEWS: Janus, Aztec-C, C/80, Morrow S-100 M26 Hard Disk System, Teleram S-100 Bubble Memory Card, Jade S-100 Bus Probe.

1981

JULY/AUGUST: 16-Bit Disk Operating Systems; Input Queuing For NorthStar; Variable Speed Automatic Slow Step; Build S-100 Clock/Calendar Card; REVIEWS: TEC-86 System, Seattle Computer 8086 System, AlphaMicro, Godbout Dual Processor, CP/M-86, Televideo 920-C Terminal.

NOVEMBER/DECEMBER: Introduction to the C Language, Virtual Segment Procedures, Little-Ada Part-II, A Disk Alignment Routine, Northstar DOS/BIOS Directory & File Conversion using UCSD Pascal; REVIEWS: BDS-C, Small-C, Tiny-C and Whitesmiths-C; Tarbell Double-Density Disk Controller



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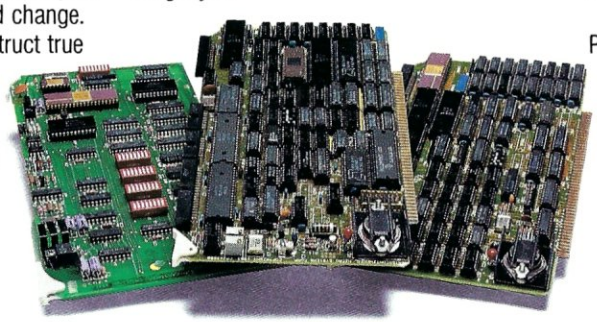

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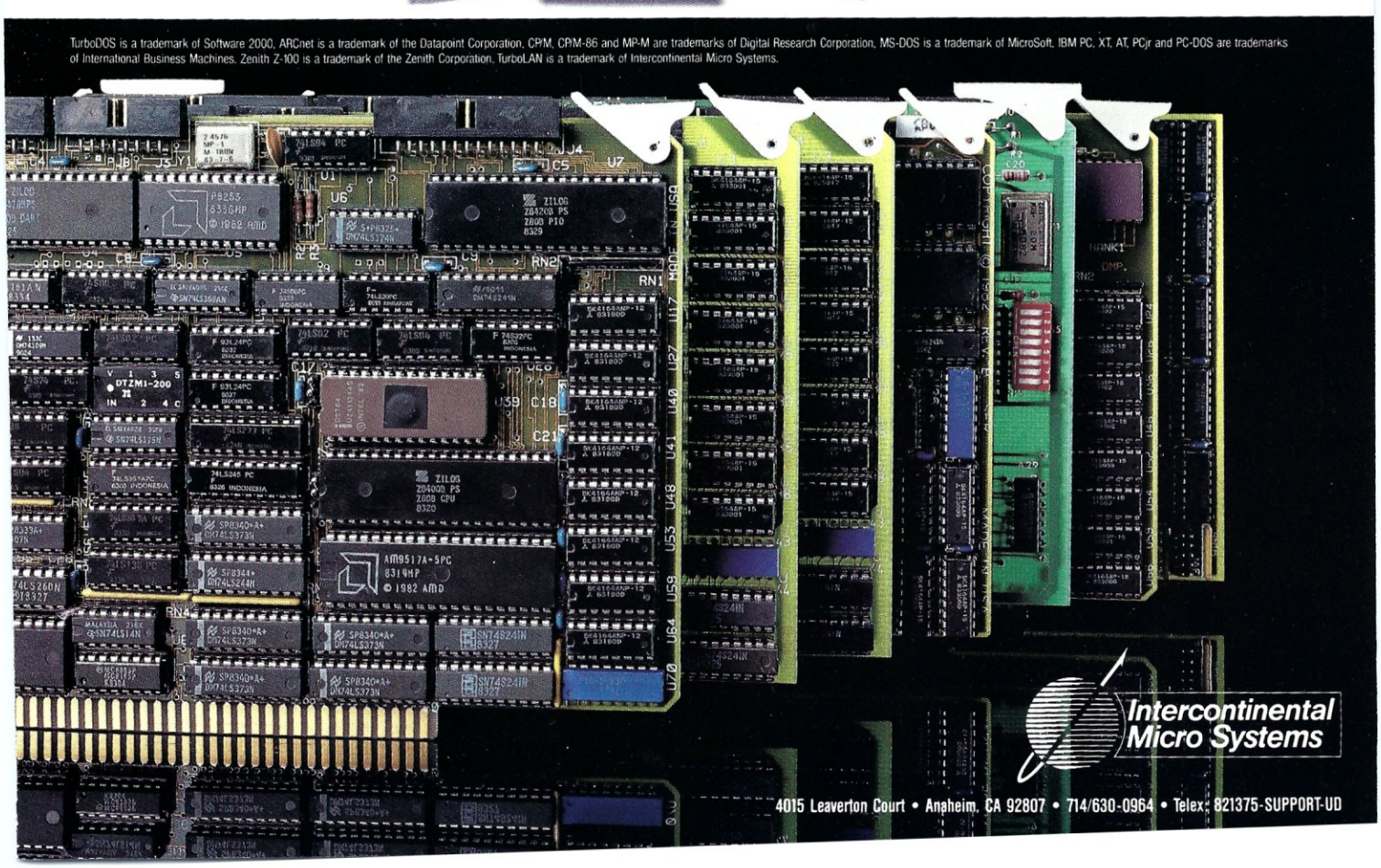

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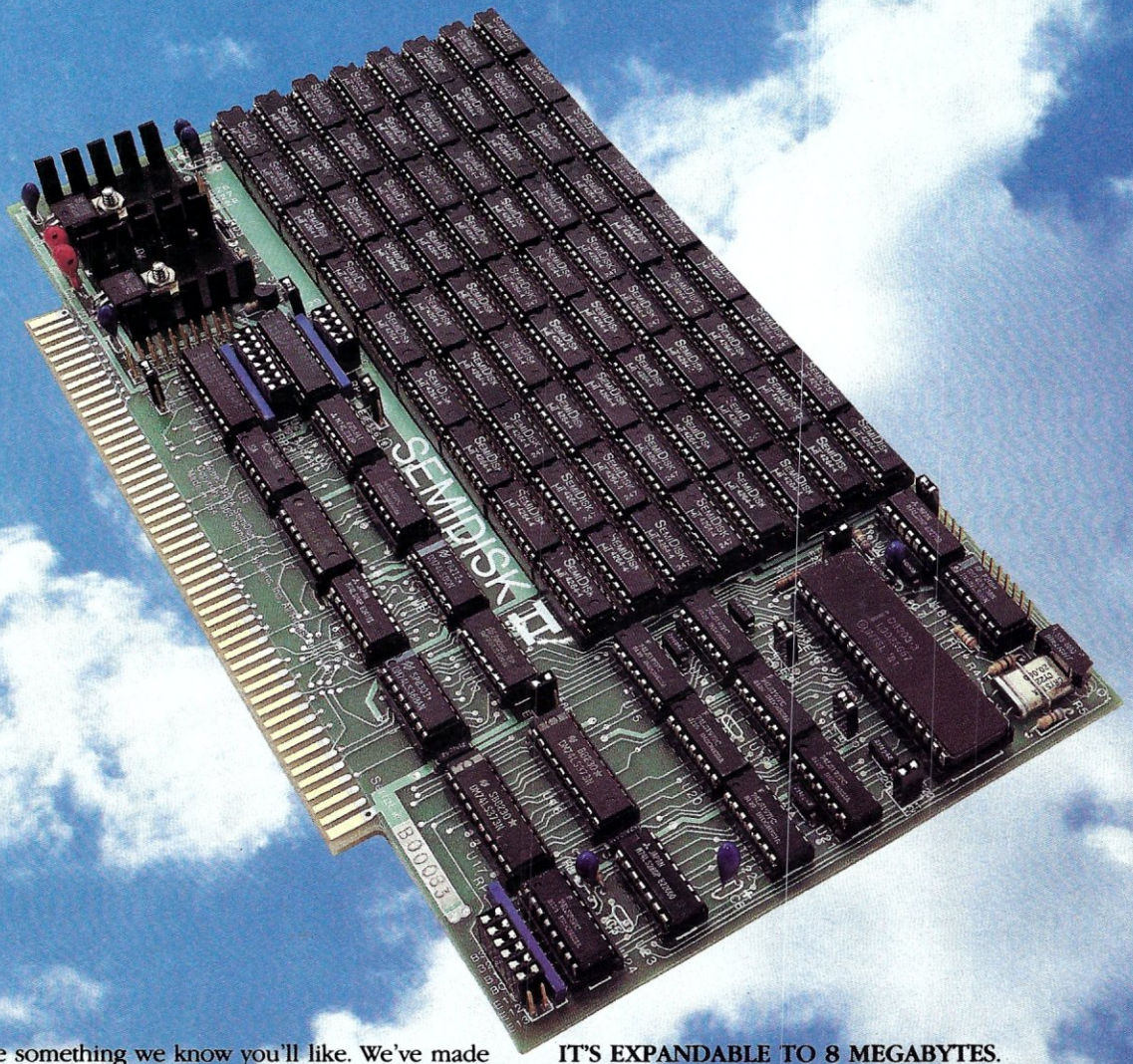

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